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EQUIVALENT WEIGHT FACTORS FOR FOUR PLASTIC BONDED EXPLOSIVES: PBX-108, PBX-109, AFX-103, AND AFX-702

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US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
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Four free-air, shock-front parameters, peak overpressure, positive impulse, time of arrival, and positive duration, were used to determine the equivalent weight factor for four plastic-bonded explosives; AFX-103, AFX-702, PBX-108, and PBX-109. The equivalent weight factor, a measure of explosive effectiveness relative to that of a scaled standard explosive, is the weight ratio of the weight of any subject explosive to the weight of a standard explosive (pentolite) for equal gage readings (pressure, time of arrival, etc.) at equal distances. (continued)

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The aluminized explosives, AFX-702 and PBX-109 were found to be more effective than the non-aluminized explosives, AFX-103 and PBX-108, over the distance interval, approximately one to eighteen meters, for which measurements were made.

Theoretical computations show that the non-aluminized explosives examined have higher pressures than the aluminized explosives within ten charge radii of the explosive.

An unexpectedly high-intensity electromagnetic pulse generated by the aluminized, plastic-bonded explosives made it impossible to make measurements at scaled distances less than 0.58 $m/Kg^{1/3}$.

Kg (to the 1/3 power).

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I. INTRODUCTION

Many military explosives are used in weapons as damage mechanisms. The effectiveness of any such explosive is generally measured in terms of its capability of producing target damage. For purposes of comparison, the effectiveness of various explosives is often expressed relative to that of a "standard" explosive such as pentolite or TNT under prescribed conditions.

For many years, the relationships between the damage-producing capability of various explosives and explosive-associated, air-blast, shock-front parameters, such as peak pressure, positive impulse, arrival time, and positive phase duration, have been studied at the BRL. The studies have shown that values of these air-blast parameters, in particular peak pressure and positive impulse, or a combination of these two, for different explosives can be used to determine their relative effectiveness. This report presents a comparison of the relative effectiveness of four plastic-bonded explosives, two aluminized and two non-aluminized, with respect to a standard (pentolite) explosive and shows the relationships between relative effectiveness and certain air-blast parameters for each of the explosives considered.

In this report, the effectiveness of each of the four plastic-bonded explosives relative to that of pentolite is expressed in terms of equivalent weight factor, EWF, of the candidate or test explosive being examined. The EWF for an explosive being tested is the charge weight, W_x, of the test explosive to the charge weight, W_s, of the standard explosive for equal gage readings, G, of one or more selected blast parameters at a distance from the center of charge, R, for the test and standard explosives. (Note that the subscripts x and s are used, respectively, to identify values of characteristics associated with the test and the standard explosive). Symbolically EWF is given by:

$$EWF = \left(\frac{W_x}{W_s}\right)_{G,R} , \qquad (1)$$

where:

W_x, W_s, G, and R are defined above,

$G = G_x = G_s$, and

$R = R_x$ for the test explosive

$R = \left(R_s/W_s^{\,1/3}\right)$, a "scaled distance", for the standard explosive.

Explosive effectiveness comparison through the use of ratios of gage readings of air-blast parameters for a particular explosive to that of a standard explosive is explained by Cole[1]. The method for determining values of EWF for such purpose, on the basis of measurement of two blast parameters or of one parameter and distance of measurement from charge center, R, has been outlined by Kinney[2], and a particular version of this method using measurements of peak pressure and impulse was proposed by Maserjian and Fisher[3]. Details for application of the EWF methodology are presented in a BRL Memorandum Report by Kingery and Jackson[4]. The use of EWF in connection with peak pressure and positive impulse envolves consideration of the following scaling laws which express these two air-blast parameters, respectively, as functions f and g of the explosive charge weight, W, of an explosive and the distance, R, of the charge center from the point of parameter measurement:

$$PM = f\left(\frac{W^{1/3}}{R}\right) \text{ , and} \tag{2}$$

$$\frac{I}{W^{1/3}} = g\left(\frac{W^{1/3}}{R}\right) \text{ ,} \tag{3}$$

where:

PM is peak excess pressure or overpressure,

I is positive impulse,

$I/W^{1/3}$ is scaled positive impulse, and

W and R are as previously defined.

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[1] *J. S. Cole, "The Measurement of Underwater Explosions from Service Weapons at the Underwater Explosive Research Laboratory," Underwater Explosion Research, Volume 1, The Shock Wave, Office of Naval Research, Department of the Navy, 1950.*

[2] *G. F. Kinney, "Explosive Shocks in Air," The MacMillan Company, New York, January 1962.*

[3] *J. Maserjian and E. M. Fisher, "Determination of Average Equivalent Weight and Average Equivalent Volume and Their Precision Indexes for Comparison of Explosives in Air," NAVORD Report 2264, U. S. Naval Ordnance Laboratory, White Oak, MD, 1951.*

[4] *C. N. Kingery and W. F. Jackson, "Blast Screening for Alternate Explosive Fill Program," BRL Memo Report No. 2236, Ballistic Research Laboratories, Aberdeen Proving Ground, MD, 1972.* (AD #907354L)

II. OBJECTIVES

The Department of Defense initiated a program to investigate the influence of explosive parameters on blast performance, i.e., on the terminal effects of blast damage mechanisms. The BRL was charged with obtaining EWF values for four plastic-bonded explosives (see Section I for definition), measuring or attempting to measure air-blast parameters in the fireball region, and compiling air-blast parameter values by computer code. The objectives of this report are to describe the BRL investigations and to present the results of the investigations, values of air-blast parameters and of EWF for the explosives considered.

III. EXPLOSIVES TESTED

The terminal effects and relative effectiveness of four plastic-bonded explosives, PBX-108, PBX-109, AFX-103, and AFX-702, were investigated in the BRL effort reported on here. Two of these explosives PBX-109 and AFX-702, are aluminized; and two, PBX-108 and AFX-103 are non-aluminized. Pentolite was used as the "standard" explosive, the basis for measurement of relative explosive effectiveness. The number of rounds of each explosive used in the tests and the composition and charge weight, W, of each are presented in Table I.

Table I. Explosive Composition and Charge Weight

Explosive Type	Explosive Composition	Charge Weight, W (kg)	Rounds Detonated
PBX-108	RDX/Plastic binder	3.949	6
PBX-109	RDX/Aℓ/Plastic binder	4.221	6
AFX-103	RDX/Plastic binder	3.949	6
AFX-702	RDX/Aℓ/Plastic binder	4.131	6
Pentolite	PETN/TNT	3.813	20

For test purposes, all of the explosives were cast spherically, A 55g booster was required for detonating the PBX and AFX explosives. A conical, molded explosive plug was used for centering the booster. M6 blasting caps were used as detonators for all rounds.

IV. EXPERIMENTAL PROCEDURES

Pressure-time histories of pressure variation resulting from detonation of an explosive at sea level were obtained by using ten gages in various locations (see Figure 1) relative to the explosive charge. Gages 1 through 6 were located 3.658 metres above ground in free air, and gages 7 through 10 were located in the mach stem region. The gage housings, which were stainless steel and pencil shaped, contained a piezoelectric transducer of lead metaniobate or quartz. Such transducers are temperature sensitive and several methods of providing thermal protection or shielding were employed. Initially, for pressures up to 500 kPa, a black electrical tape was used to cover the transducers, and for pressures above 500 kPa, an aluminum paint over a special primer was used. In the final stages of testing a heat reflective tape with glass cloth backing (3M Company Tape No. 363) was used for pressures above 500 kPa.

The pressure pulses detected by the gages were amplified and recorded on a Honeywell Model 7600 magnetic tape recorder with a band width of zero to eighty-five kHz. All gages had source followers in the probe housing, hence extraneous noise due to long cables was eliminated.

V. ANALYSIS OF DATA

Typical magnetic-tape recordings of pressure-time histories obtained in the investigation are presented in Figures 2 through 6. Figures 2 through 5 show free-air-related histories, and Figure 6 shows mach stem region-related histories. Figures 2, 4, 5, and 6 present comparisons of histories for pentolite and the aluminized explosive PBX-109.

Figure 3 presents two pressure-time histories for the PBX-109 explosive which were recorded in the high-pressure, fireball region. The upper record, which is also shown as the lower record in Figure 2, is the only fireball-region record for an aluminized explosive which was not destroyed by an intense electromagnetic pulse resulting from the detonation. The lower record in Figure 3 is typical of pressure-time histories destroyed by this phenomenon. Of course, the pulse affected all of the pressure-time records for the aluminized explosives, but only the records of histories in the fireball region were totally destroyed.

The pentolite pressure-time histories have the same pressure-time decay characteristics as those of the non-aluminized explosives, PBX-108 and AFX-103. Figures 2, 4, 5, and 6 show a shifting of the second peak to the left for the aluminized explosive, PBX-109. This is

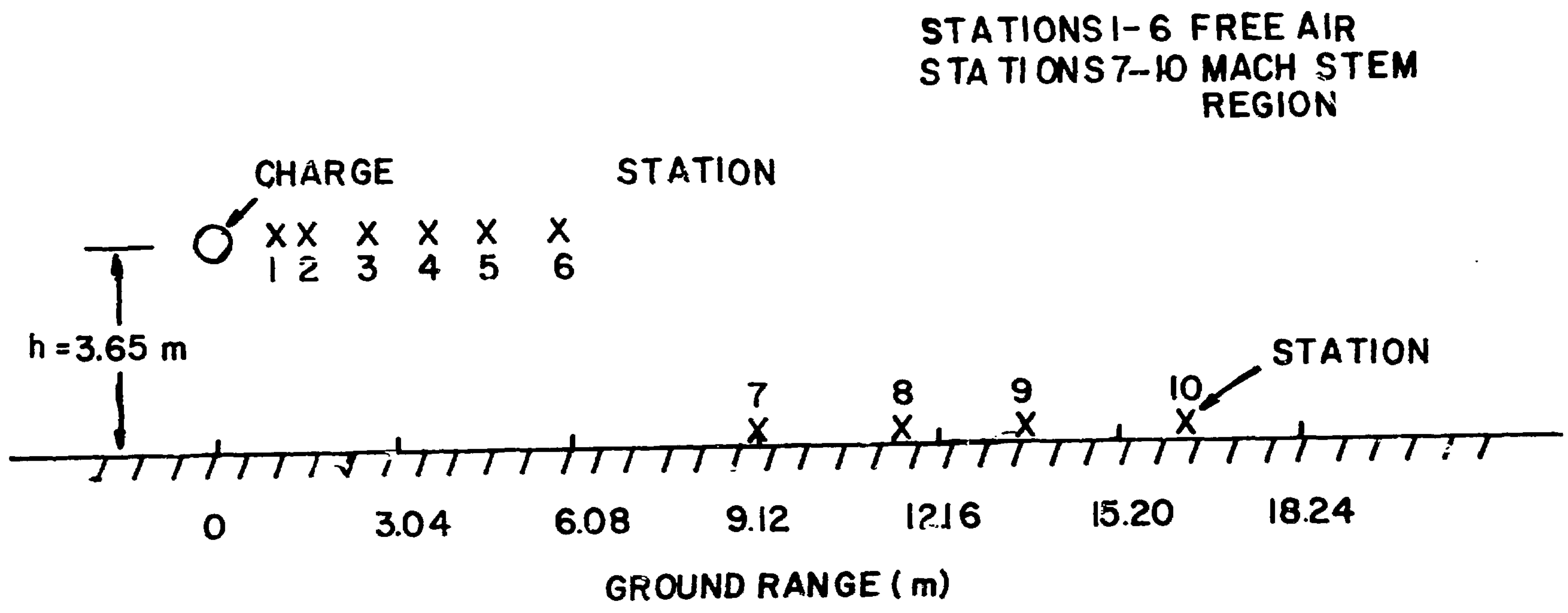

Figure 1. Gage Locations

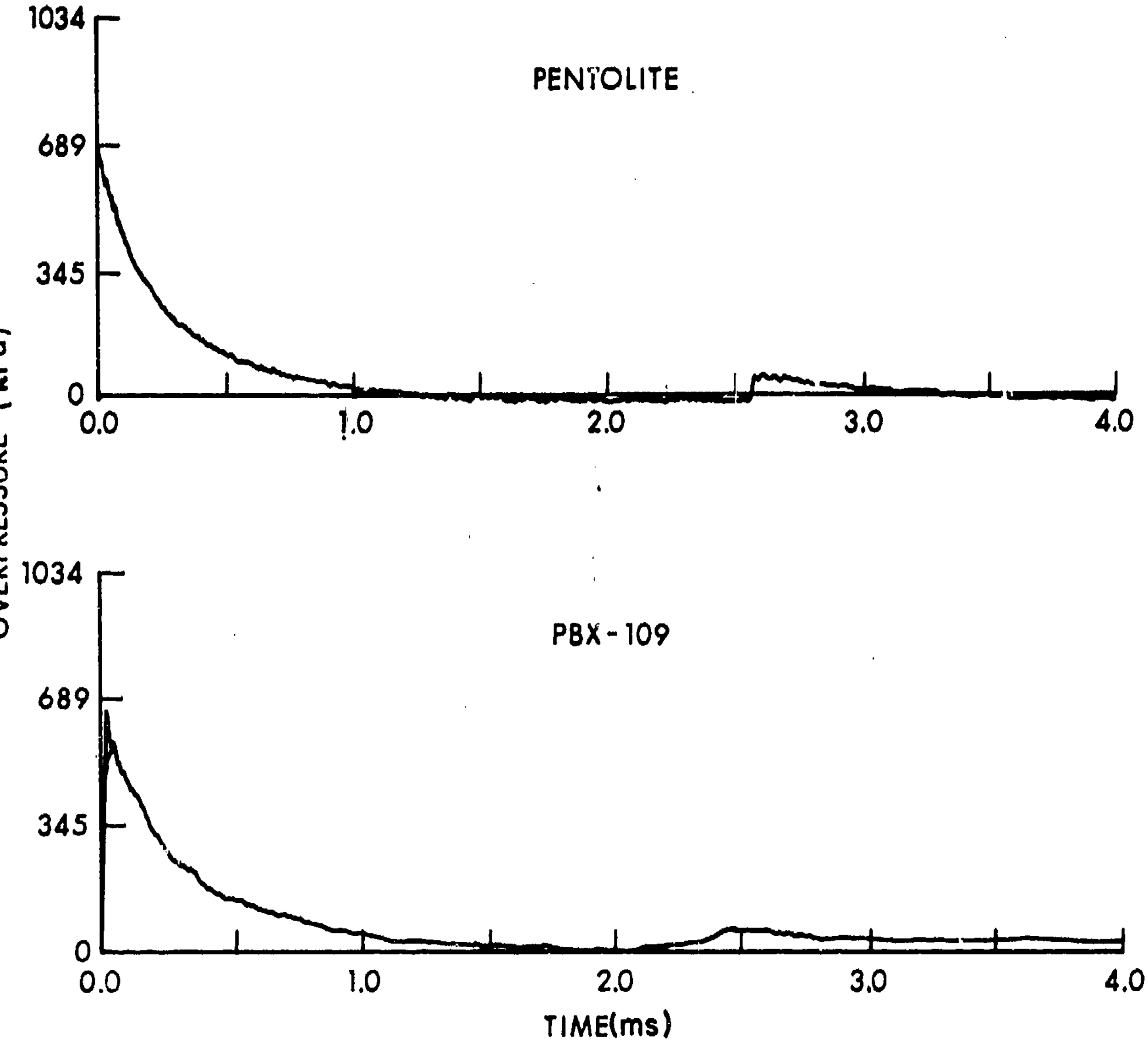

Figure 2. Pressure-Time Histories at 1.98 m in Free Air.

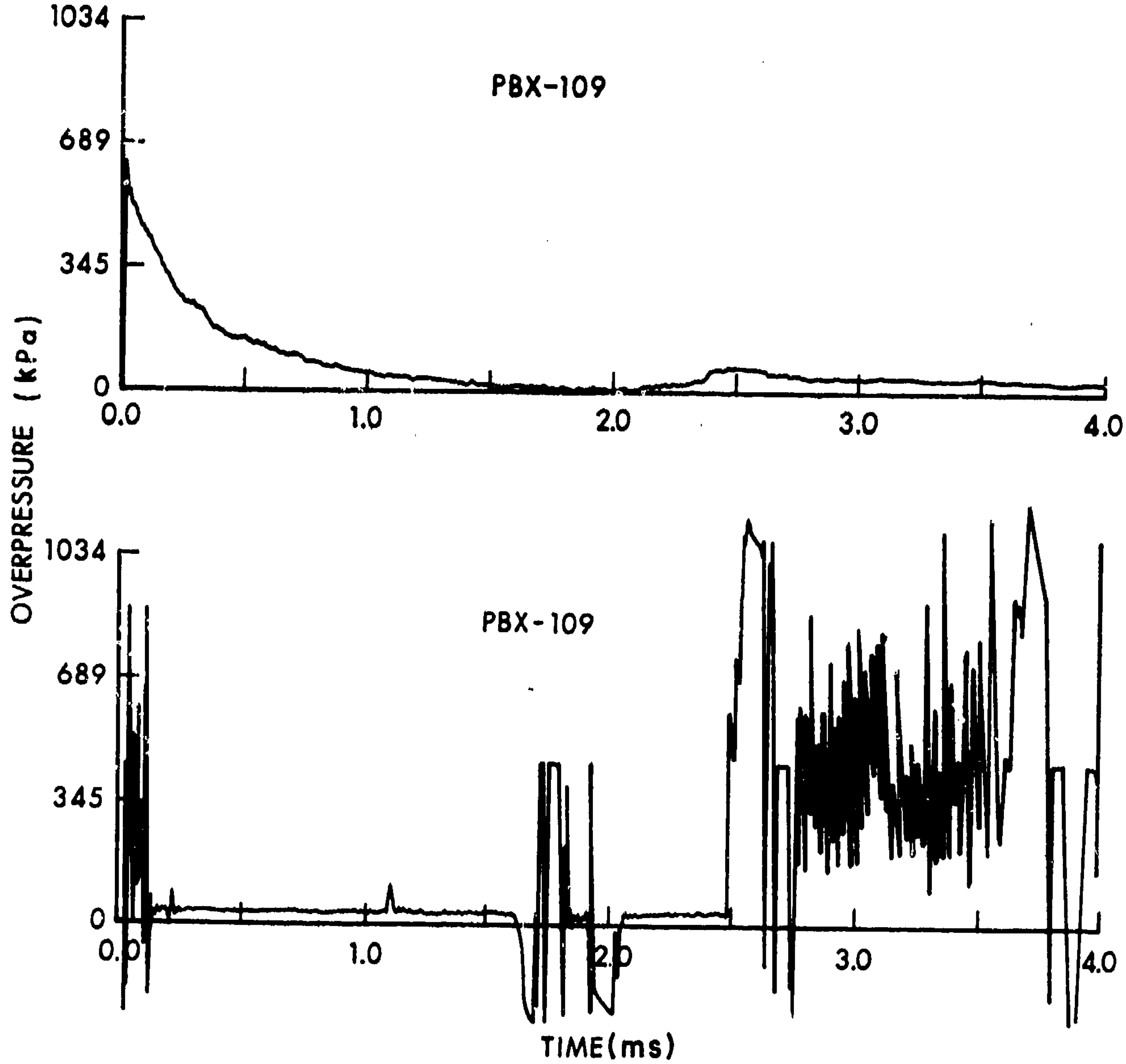

Figure 3. Pressure-Time Histories at 1.98 m in Free Air.

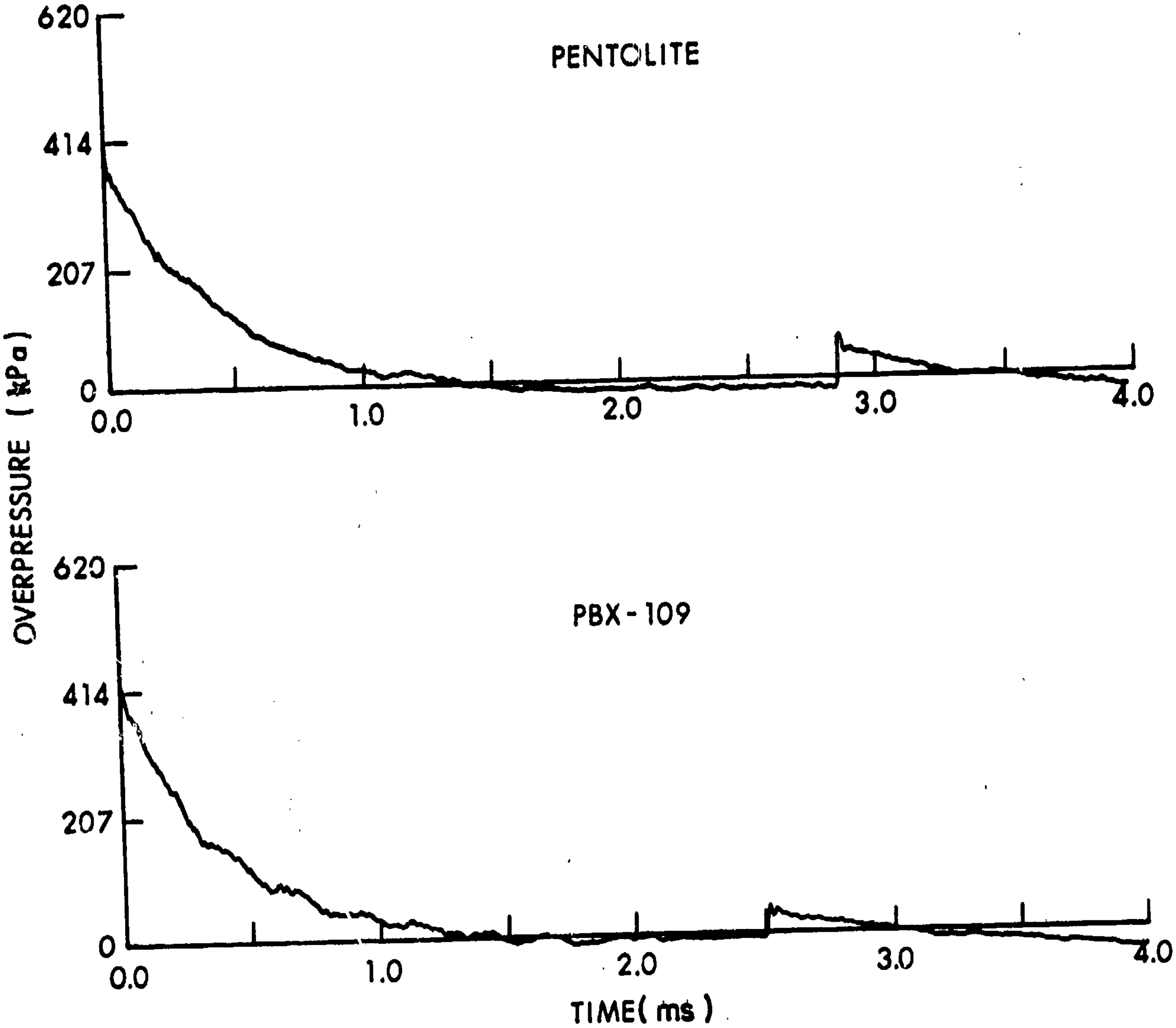

Figure 4. Pressure-Time Histories at 2.36 m in Free Air.

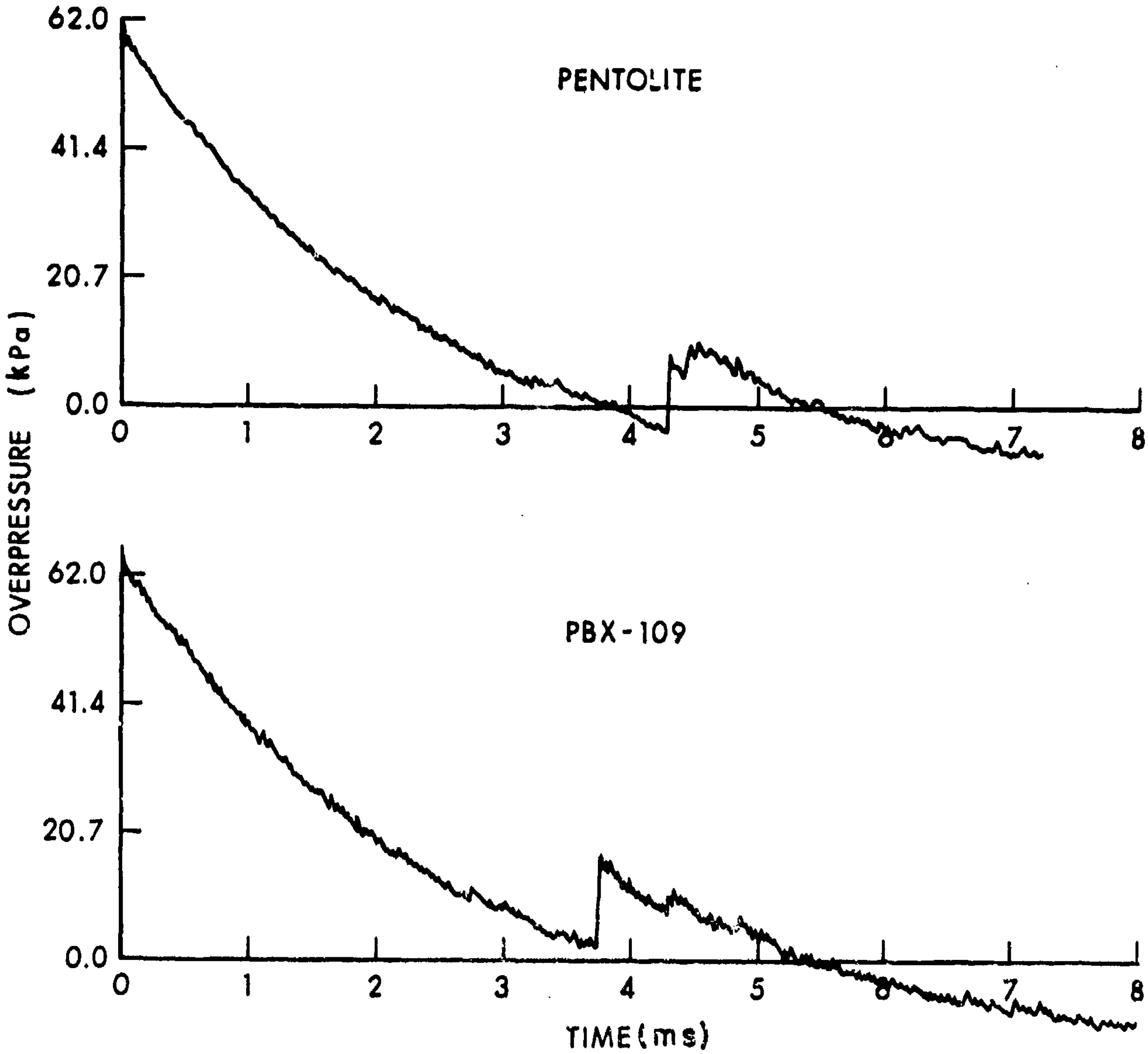

Figure 5. Pressure-Time Histories at 6.0m in Free Air.

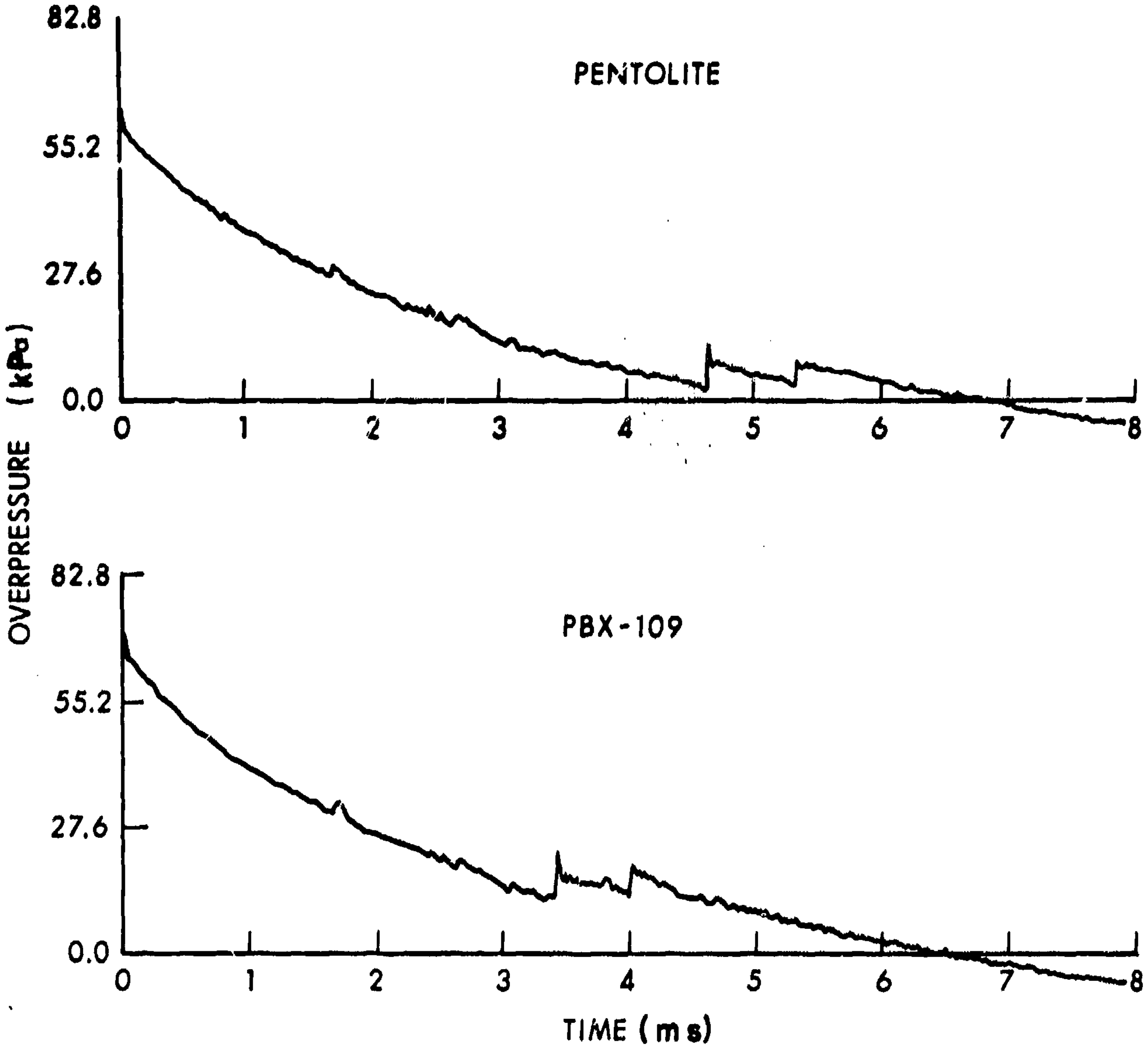

Figure 6. Pressure-Time Histories at 9.14 m in Mach Stem Region.

characteristic of aluminized explosives and is due to afterburning[5]. For persons familiar with blast parameter measurement, Figures 2, 4, 5, and 6 also show the difficulty of defining positive duration and positive impulse for aluminized explosive detonations.

The data recorded on magnetic tape were digitized by the Computer Support Division, BRL. The digitized data were entered as input to a Fortran program and values of shock-front parameters, such as, peak excess pressure, PM, positive impulse, I, arrival time, t_a, and positive phase duration, t_+, were determined.

The lower pressure-time record, for PBX-109, in Figure 2 shows the finite time required to record the peak pressure with the piezoelectric gage. For most cases the pressure-time relationship may be expressed as a function of time after arrival of the shock front, t, by the exponential decay expression,

$$p = PM \exp(-C_1 t), \tag{4}$$

where:

t is elapsed time after arrival of shock front (note: $t = o \Rightarrow t = t_a$),

p is excess pressure at time t,

PM is as previously defined, and

C_1 is the decay constant; or by

the Friedlander formula,

$$p = PM \left(1 - \frac{t}{t_+}\right) \exp(-C_2 t), \tag{5}$$

where:

t_+ is the time of positive phase duration, and

p, PM, and t are as previously defined, and

C_2 is the decay constant; or by

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[5] *C. C. Matle, E. M. Fisher and T. O. Anderson, "The Contribution of Afterburning to Air Blast from Aluminized Explosives (U)," NOL, White Oak, MD, June 1967.*

a fit to the data of a cubic in t of the form,

$$p_i = a_{i0} + a_{i1} t + a_{i2} t^2 + a_{i3} t^3, \qquad (6)$$

where:

$i = 1,2,\ldots$ is the number of equations selected to describe the data

p_i is the value of p in the i-th equation

a_{i0}, a_{i1}, a_{i2}, and a_{i3} are undetermined decay coefficients in equation i, and

t is as previously defined.

It has been found that Equation 6 will provide a very reasonable fit to the total range of positive phase data if coefficients are determined for data in several intervals over the range which are defined by "break points" and if a proper selection of break points is made in accord with the cubic spline method of curve fitting[6]. The Friedlander formula, Equation 5, does not provide a good approximation for p if the pressure levels are very high. Differences among Equations 4, 5, and 6 are reflected to some extent by comparison of the following expressions for the rate of change in the natural logarithm of p with respect to time: from Equation 4,

$$\frac{d}{dt} \ln p = - C_1 \, , \qquad (7)$$

from Equation 5,

$$\frac{d}{dt} \ln p \bigg|_{t=0} = - C_2 - \frac{1}{t_+} \, , \qquad (8)$$

and from Equation 6,

$$\frac{d}{dt} \ln p_i \bigg|_{t=0} = \frac{a_{i1}}{a_{i0}} \, . \qquad (9)$$

[6]*Palmer R. Schlegel, "The Cubic Spline - A Curve Fitting Procedure," Ballistic Research Laboratories Report No. 1253, July 1963.* (AD #451085)

Positive impulse, I, of the shock front is related to excess pressure, p, by the equation,

$$I = \int_0^{t_+} p \, dt. \tag{10}$$

Similarly, the shock front energy, E, is related to excess pressure, p, by the equation,

$$E = \int_0^{t_+} p^2 \, dt. \tag{11}$$

Tables II, IIa through VI, VIa present scaled measured values and computed values ("a" tables) and standard deviation, SIGMA, of a number of characteristic parameters for the standard pentolite and each of the four plastic-bonded explosives considered in this report. The parameter values in Tables II through VI were derived from test measurements; those in Tables IIa through VIa were obtained through application of Equations 7, 9, and 11. The arguments for entering the tables are explosive identification and a range of values of scaled distance, Z ($= R/W^{1/3}$). The parameters for which values are given in the tables are:

peak excess pressure, PM,

scaled positive impulse, IMP ($= I/W^{1/3}$),

scaled positive phase duration, TD ($= t_+/W^{1/3}$),

scaled arrival time, TA ($= t_a/W^{1/3}$),

scaled energy, EN ($= E/W^{1/3}$), and

scaled decay constant, DC_1 ($= C_1/W^{1/3}$).

Additional scaled measured values of characteristic parameters for pentolite, some of which were acquired from other experiments and the remainder of which were extracted from Reference 7, are presented in Appendix Table A-I. Appendix Tables A-II through A-V present measured values of peak excess pressure, PM, positive impulse, I, arrival time, t_a, and positive phase duration, t_+, for the plastic-bonded explosives AFX-103, AFX-702, PBX-108, and PBX-109. The data presented in Tables A-II through A-V were acquired in the experiments described in this report. Appendix Table A-VI presents a computer tabulation of smoothed

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[7] *Dewey, J. M., Miller, A. R., and Williams, J. S., "Air Blast from Three Military Explosives," BRL Report No. 1556, Ballistic Research Laboratories, Aberdeen Proving Ground, MD, October 1971.* (AD #890260L)

Table II. Scaled Measured Blast Properties of Spherical Pentolite

Z $m/kg^{1/3}$	PM kPa	SIGMA kPa	IMP $kPa\text{-}ms/kg^{1/3}$	SIGMA $kPa\text{-}ms/kg^{1/3}$	TD $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$	TA $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$
0.588	3347.	396.3	196.5	17.25	0.173	0.032	0.2050	0.005
1.271	646.3	70.05	119.9	7.476	0.925	0.084	0.7760	0.185
1.515	450.2	14.68	111.2	6.477	1.069	0.112	1.087	0.134
1.906	232.8	18.95	93.95	5.279	1.476	0.056	1.783	0.032
2.444	148.2	9.688	86.19	5.075	1.796	0.045	2.822	0.029
3.847	57.61	2.858	55.03	2.229	2.552	0.056	6.104	0.057
5.871	58.61	2.917	66.39	4.360	3.131	0.084	12.06	0.099
7.434	31.50	7.046	41.03	10.17	3.400	0.179	16.06	0.123
8.803	32.05	1.652	47.60	2.548	3.851	0.117	19.67	0.146
10.61	24.37	0.224	44.98	8.676	3.962	0.043	24.31	0.367

Table IIa. Scaled Computed Blast Properties of Spherical Pentolite

Z $m/kg^{1/3}$	10^{-3} EN $MPa^2 - ms/kg^{1/3}$	10^{-3} SIGMA $MPa^2 - ms/kg^{1/3}$	DC_1 $1/ms\ kg^{1/3}$	SIGMA $1/ms\ kg^{1/3}$
0.588	367.0	82.29	-7.085	2.494
1.271	36.45	5.695	-2.744	0.525
1.515	24.70	1.618	-1.744	0.102
1.906	11.89	1.557	-0.904	0.442
2.444	7.076	0.776	-0.575	0.014
3.847	1.849	0.126	-0.320	0.014
5.871	2.161	0.238	-0.405	0.100
7.434	0.763	0.357	-0.284	0.018
8.803	0.862	0.090	-0.244	0.033
10.61	0.609	0.061	-0.193	0.006

Z = scaled distance
PM = peak excess pressure
IMP = scaled positive phase impulse
TD = scaled positive duration
TA = scaled shock arrival time
EN = scaled energy
DC_1 = scaled decay constant
SIGMA = standard derivation

Table III. Scaled Measured Blast Properties of Spherical AFX-103

Z $m/kg^{1/3}$	PM (kPa)	SIGMA (kPa)	IMP $kPa\text{-}ms/kg^{1/3}$	SIGMA $kPa\text{-}ms/kg^{1/3}$	TD $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$	TA $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$
0.579	2635.	506.7	214.0	-	0.280	-	0.208	0.002
1.254	685.9	12.59	-	-	-	-	0.748	0.002
1.495	470.6	11.44	127.3	-	-	-	1.040	-
1.882	226.6	21.46	90.36	23.52	1.194	0.282	1.768	0.056
2.412	151.6	8.949	84.55	11.77	1.707	0.231	2.749	0.075
3.796	59.70	1.302	48.02	1.984	2.459	0.256	5.957	0.12
5.788	64.74	2.810	81.22	4.291	2.919	0.158	11.59	0.13
7.331	31.15	2.738	64.32	7.604	3.150	0.497	15.42	0.19
8.680	30.05	2.287	63.47	44.98	3.044	0.802	18.89	0.12

Table IIIa. Scaled Computed Blast Properties of Spherical AFX-103

Z $m/kg^{1/3}$	10^{-3} EN $MPa^2 - ms/kg^{1/3}$	10^{-3} SIGMA $MPa^2 - ms/kg^{1/3}$	DC_1 $1/ms\ kg^{1/3}$	SIGMA $1/ms\ kg^{1/3}$
0.579	236.0	122.2	-9.500	-
1.254	37.30	4.33	-2.784	0.552
1.495	26.41	0.952	-1.721	0.236
1.882	12.11	2.19	-0.83	0.022
2.412	7.484	0.646	-0.560	0.054
3.796	1.986	0.132	-0.339	0.066
5.788	2.593	0.248	-0.485	0.122
7.331	0.641	0.101	-0.276	0.040
8.680	0.7348	0.086	-0.23	0.036

Table IV. Scaled Measured Blast Properties of Spherical AFX-702

Z $m/kg^{1/3}$	PM kPa	SIGMA kPa	IMP $kPa\text{-}ms/kg^{1/3}$	SIGMA $kPa\text{-}ms/kg^{1/3}$	TD $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$	TA $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$
0.567	4094.	37.05	214.0	-	0.253	-	0.208	0.002
1.230	839.8	62.89	-	-	-	-	0.748	0.002
1.465	496.6	9.067	127.3	-	-	-	1.040	-
1.846	231.5	33.16	90.36	23.52	1.194	0.282	1.768	-
2.368	139.3	28.18	85.00	11.77	1.707	0.231	2.749	0.056
3.693	57.16	3.846	48.02	1.984	2.459	0.256	5.934	0.075
5.681	64.45	4.094	81.22	4.291	2.919	0.158	11.59	0.116
7.196	42.08	1.105	64.32	7.604	3.150	0.497	15.42	0.194
8.521	31.40	7.267	6.347	44.98	3.044	0.802	18.89	0.123

Table IVa. Scaled Computed Blast Properties of Spherical AFX-702

Z $m/kg^{1/3}$	10^{-3} EN $MPa^2 - ms/kg^{1/3}$	10^{-3} SIGMA $MPa^2 - ms/kg^{1/3}$	DC_1 $1/ms\ kg^{1/3}$	SIGMA $1/ms\ kg^{1/3}$
0.567	387.2	-	-14.17	2.940
1.230	-	-	- 4.079	-
1.465	28.90	0.721	- 4.180	0.423
1.846	11.97	3.955	- 1.005	0.292
2.368	7.070	1.290	- 0.667	0.161
3.693	1.302	0.013	- 0.301	0.038
5.681	2.829	0.172	- 0.297	0.029
7.196	1.687	0.632	- 0.244	0.022
8.521	1.780	2.047	- 0.206	0.012

Table V. Scaled Measured Blast Properties of Spherical PBX-108

Z $m/kg^{1/3}$	PM (kPa)	SIGMA (kPa)	IMP ($kPa\text{-}ms/kg^{1/3}$)	SIGMA ($kPa\text{-}ms/kg^{1/3}$)	TD ($ms/kg^{1/3}$)	SIGMA ($ms/kg^{1/3}$)	TA ($ms/kg^{1/3}$)	SIGMA ($ms/kg^{1/3}$)
0.580	3141.	168.8	211.0	12.69	0.286	-	0.202	0.006
1.254	671.2	107.7	129.2	11.77	1.161	0.407	0.736	0.022
1.495	469.3	31.84	109.4	7.978	1.00	0.093	1.043	0.033
1.874	236.0	22.46	95.83	7.690	1.429	0.070	1.685	0.094
2.411	151.0	9.929	84.93	3.338	1.748	0.026	2.716	0.119
3.794	58.10	3.55	56.38	2.109	2.532	0.087	5.884	0.138
5.788	61.71	2.89	75.20	2.091	3.124	0.088	11.71	0.095
7.319	36.12	7.498	46.02	9.413	3.463	0.212	15.61	0.095
8.684	32.85	1.791	48.42	3.266	3.817	0.118	19.12	0.121
10.46	25.41	-	42.66	-	-	-	23.73	-

Table Va. Scaled Computed Blast Properties of Spherical PBX-108

Z $m/kg^{1/3}$	10^{-3} EN ($MPa^2 - ms/kg^{1/3}$)	10^{-3} SIGMA ($MPa^2 - ms/kg^{1/3}$)	DC_1 ($1/ms\ kg^{1/3}$)	SIGMA ($1/ms\ kg^{1/3}$)
0.580	272.8	2.196	-9.869	2.871
1.254	37.87	-	-2.624	2.885
1.495	25.74	3.139	-2.087	0.699
1.874	12.11	2.097	-0.911	0.070
2.411	7.658	0.513	-0.657	0.159
3.794	1.977	0.151	-0.253	0.127
5.788	2.464	0.170	-0.379	0.082
7.319	0.9167	0.400	-0.288	0.053
8.684	0.9752	0.153	-0.248	0.035
10.46	0.6114	-	-0.191	-

Table VI. Scaled Measured Blast Properties of Spherical PBX-109

Z $m/kg^{1/3}$	PM kPa	SIGMA kPa	IMP $kPa\text{-}ms/kg^{1/3}$	SIGMA $kPa\text{-}ms/kg^{1/3}$	TD $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$	TA $ms/kg^{1/3}$	SIGMA $ms/kg^{1/3}$
0.566	-	-	-	-	-	-	0.250	-
1.224	674.3	39.85	130.2	4.052	1.180	0.115	0.751	0.015
1.460	479.6	93.98	123.7	-	0.995	0.123	1.042	0.52
1.836	223.2	37.79	82.64	25.47	1.224	0.325	1.639	0.259
2.354	156.7	13.78	85.52	11.50	1.643	0.213	2.510	0.357
3.703	57.72	0.424	50.48	10.05	2.421	0.315	5.801	0.189
5.649	61.83	-	66.87	-	3.064	-	11.35	-
7.156	39.62	-	49.59	-	3.258	-	15.18	-
8.477	29.70	-	35.25	-	2.857	-	18.62	-
10.17	-	-	-	-	-	-	23.05	-

Table VIa. Scaled Computed Properties of Spherical PBX-109

Z $m/kg^{1/3}$	10^{-3} EN $MPa^2\text{-}ms/kg^{1/3}$	10^{-3} SIGMA $MPa^2\text{-}ms/kg^{1/3}$	DC_1 $1/ms\ kg^{1/3}$	SIGMA $1/ms\ kg^{1/3}$
0.566	-	-	-	-
1.224	37.35	-	-3.431	-
1.460	30.41	-	-1.837	-
1.836	10.55	4.874	-0.895	0.104
2.354	7.636	1.491	-0.621	0.117
3.703	1.690	0.418	-0.323	0.031
5.649	-	-	-0.311	-
7.156	-	-	-0.242	-
8.477	-	-	-0.292	-
10.17	-			

scaled values of peak excess pressure, arrival time, and positive impulse measured for pentolite in these experiments. The argument for entering Table A-VI is scaled distance, Z. The smoothed values were obtained by fitting a series of cubic equations in scaled distance, Z, to values of the logarithms of the scaled data, including positive phase duration for which such values were inadvertically omitted in the Table A-VI tabulation. The cubic equations were of a form similar to Equation 6 with the coefficients, in this case, identified as C0, C1, C2, and C3. A computer program embodying the cubic spline method of curve fitting was used to obtain the "best fit" to the data. The values of the coefficients defining the fit and the upper and lower bounds of selected intervals of scaled distance, i.e., the "break points" of the cubic spline method for this evaluation, for each equation are presented in Appendix Table A-VII. Appendix Figures A-1 through A-4 are computer drawn curves showing the fit of the cubic equations to the empirically measured values, respectively, of peak excess pressure, arrival time, and positive impulse for pentolite in free air. Appendix Figures A-5 through A-8 are similar curves for empirically measured values of the same parameters for pentolite in the mach stem region.

Since Kinney's[2] method of comparing the effectiveness of any explosive to that of a standard explosive by using an equivalent weight factor, EWF, assumes scaling and is dependent upon total energy release at the surface of the explosive charge, the appropriate values of parameters, computed for the standard pentolite explosive and empirically determined for the test explosives, were used in the scaling equations to obtain values of equivalent weight factor, EWF.

When peak maximum pressure, PM, and distance of measurement from charge center, R, are of interest, the computation for EWF is simple, since PM does not scale with the cube root of the weight. In such case:

$$EWF = \frac{W_x}{W_s} = \left(\frac{R_x}{Z_s}\right)^3_{PM_x,\ R_x} , \qquad (12)$$

where:

W_x/W_s is in effect, here as it is also in Equations 13, 14, and 15 below, the right hand number $(W_x/W_s)_{G,R}$, of Equation 1. Consequenty, the dependence of EWF on R as defined for Equation 1 is implicit in Equations 12 through 15.

Similary when PM and any other parameter is of interest:

$$EWF = \frac{W_x}{W_s} = \left(\frac{G_x}{GG_s}\right)_{PM_x,\ G_x} , \qquad (13)$$

where:

G_x is the gage reading of the second blast parameter, e.g., of I_x, $t_{a,x}$, $t_{+,x}$, for the test explosive, and

GG_s is the scaled value of the gage reading of the same blast parameter for the standard explosive.

When a blast parameter other than PM is of interest, the computation for EWF is somewhat more complicated since it is necessary to evaluate ratios of the parameter, e.g., I, t_a, or t_+, and the distance, R, or of two parameters, e.g., I and t_a, for the test explosive and of the corresponding scaled parameter and distance or of the corresponding scaled parameters for the standard explosive. Thus for I and R, for example, EWF is given by:

$$EWF = \frac{W_x}{W_s} = \left(\frac{I_x/R_x}{IMP_s/Z_s}\right)^3_{I_x,\ R_x} , \qquad (14)$$

(compare with Equation 12). And for I and t_a, for example, EWF is given by:

$$EWF = \frac{W_x}{W_s} = \left(\frac{I_x/t_{a,x}}{IMP_s/TA_s}\right)^3_{I_x,\ t_{a,x}} , \qquad (15)$$

(compare with Equation 13).

Tables VII through IX present values of EWF for the four test explosives, derived from application of Equations 12 through 15, based on consideration of several combinations of blast parameters or of a blast parameter and the distance R. Figures 7 through 9 present plots of selected values of EWF versus R_x from Tables VII and VIII.

The Tamer[8] code was used to develop theoretical pressure-distance relationships; values of the ratio PM/P_o, where P_o is ambient pressure; for a range of values of scaled distance, Z, for pentolite, for each of the four plastic-bonded test explosives, and for the standard aluminized

[8]*61JTCG/ME-10-3, "The Joint Service Evaluation for Preferred and Alternate Explosive Fills in Principal Munitions (U)," Volume III, Annex 7 (U), Tinker AFB, Okla., December 1970.*

Table VII. Test Explosive Values of EWF Based on PM, R and on PM, I

PARAMETERS Basis	R_x m	TEST EXPLOSIVE AFX 103	AFX 702	PBX 108	PBX 109
PM, R (Eq. 12)	0.914	0.958	1.281	0.975	-
	1.981	1.032	1.382	1.109	1.044
	2.362	1.029	1.058	1.038	1.164
	2.972	0.981	1.029	1.027	1.128
	3.810	1.066	1.036	1.057	1.053
	5.995	1.004	0.975	.982	1.036
	Avg.	1.012	1.127	1.031	1.085
	9.144	1.199	1.210	1.110	1.126
	11.58	-	1.490	-	1.115
	13.72	1.002	1.295	1.036	1.108
	16.46	-	-	1.110	-
	Avg.	1.100	1.332	1.085	1.116
PM, I (Eq. 13)	0.914	-	-	-	-
	1.981	1.349	-	1.096	-
	2.362	1.027	1.753	1.187	1.127
	2.972	1.120	1.124	1.103	-
	3.810	1.099	1.656	1.320	0.956
	5.995	1.285	1.682	1.192	1.564
	Avg.	1.176	1.554	1.180	1.216
	9.144	1.101	1.554	1.086	1.351
	11.58	-	1.156	-	1.206
	13.72	1.094	1.825	1.060	1.222
	16.46	-	-	-	-
	Avg.	1.098	1.512	1.073	1.260

Free air 9.144 > R_x > 9.144 Mach Stem

R_x = distance from center of explosive to gage.

PM = peak excess pressure.

I = positive impulse.

Table VIII. Test Explosive Values of EWF Based on I, R and on PM, t_a

PARAMETERS	R_x m	TEST EXPLOSIVE AFX 103	AFX 702	PBX 108	PBX 109
I, R (Eq. 14)	0.914	-	-	-	-
	1.981	1.165	-	1.006	-
	2.362	1.022	1.508	1.088	1.138
	2.972	1.040	1.334	1.082	1.759
	3.810	1.072	1.470	1.178	1.411
	5.995	1.097	1.282	1.052	1.153
	Avg.	1.079	1.398	1.082	1.365
	9.144	1.145	1.383	1.096	1.209
	11.58	-	1.301	-	1.159
	13.72	1.011	1.357	1.047	1.166
	16.46	-	-	-	-
	Avg.	1.078	1.414	1.072	1.178
PM, t_a (Eq. 13)	0.914	-	1.835	0.975	-
	1.981	1.146	1.606	1.064	1.224
	2.362	1.073	1.303	1.145	1.664
	2.972	1.078	1.242	1.093	1.467
	3.810	1.147	1.147	1.069	1.164
	5.995	1.062	1.026	0.9830	0.950
	Avg.	1.101	1.360	1.055	1.294
	9.144	1.186	1.233	1.077	1.108
	11.58	-	1.583	-	1.197
	13.72	0.963	1.336	1.024	1.086
	16.46	-	-	1.062	-
	Avg.	1.074	1.384	1.054	1.130

Free air 9.114 > R_x > 9.114 Mach Stem

R_x = distance from center of charge to gage.

I = positive phase impulse.

PM = peak excess pressure.

t_a = time of arrival of shock front.

Table IX. Test Explosive Values of EWF Based on I, t_a

PARAMETERS	R_x m	TEST EXPLOSIVE AFX 103	AFX 702	PBX 108	PBX 109
I, t_a (Eq. 15)	0.914	-	-	1.334	-
	1.981	1.188	-	1.022	-
	2.362	1.024	1.652	1.175	1.220
	2.972	1.084	1.126	1.095	-
	3.810	1.086	1.565	1.255	0.962
	5.995	1.165	1.438	1.049	1.208
	Avg.	1.109	1.443	1.155	1.130
	9.144	1.135	1.410	1.080	1.209
	11.58	-	1.306	-	1.153
	13.72	1.000	1.602	1.031	1.162
	14.46	-	-	-	-
	Avg.	1.068	1.439	1.055	1.175

Free air 9.144 > R > 9.144 Mach Stem

R_x = Distance from center of explosive to gage.

I = positive phase impulse.

t_a = time of arrival of shock front.

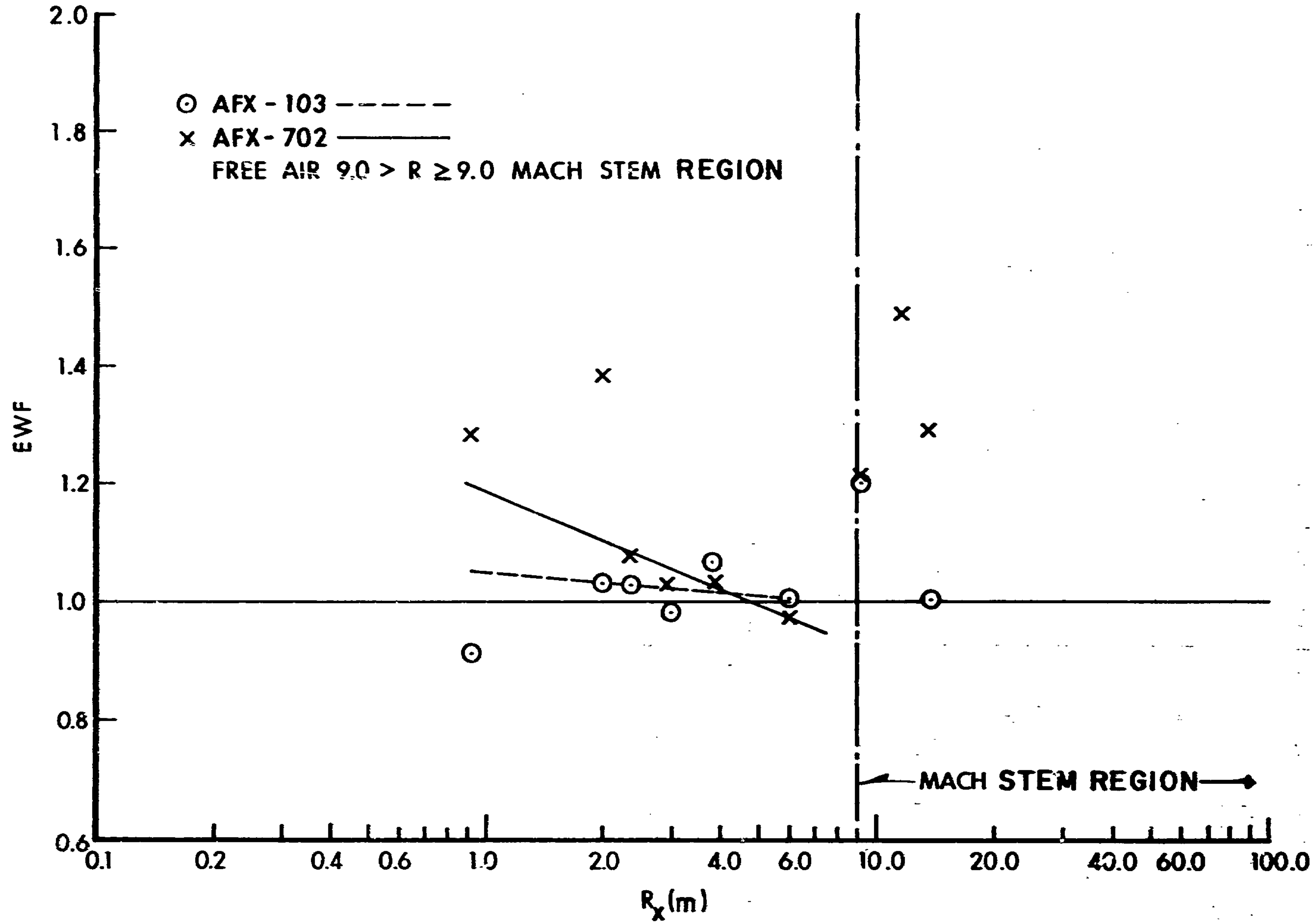

FIGURE 7. EWF; BASED on PM, R; versus R_x.

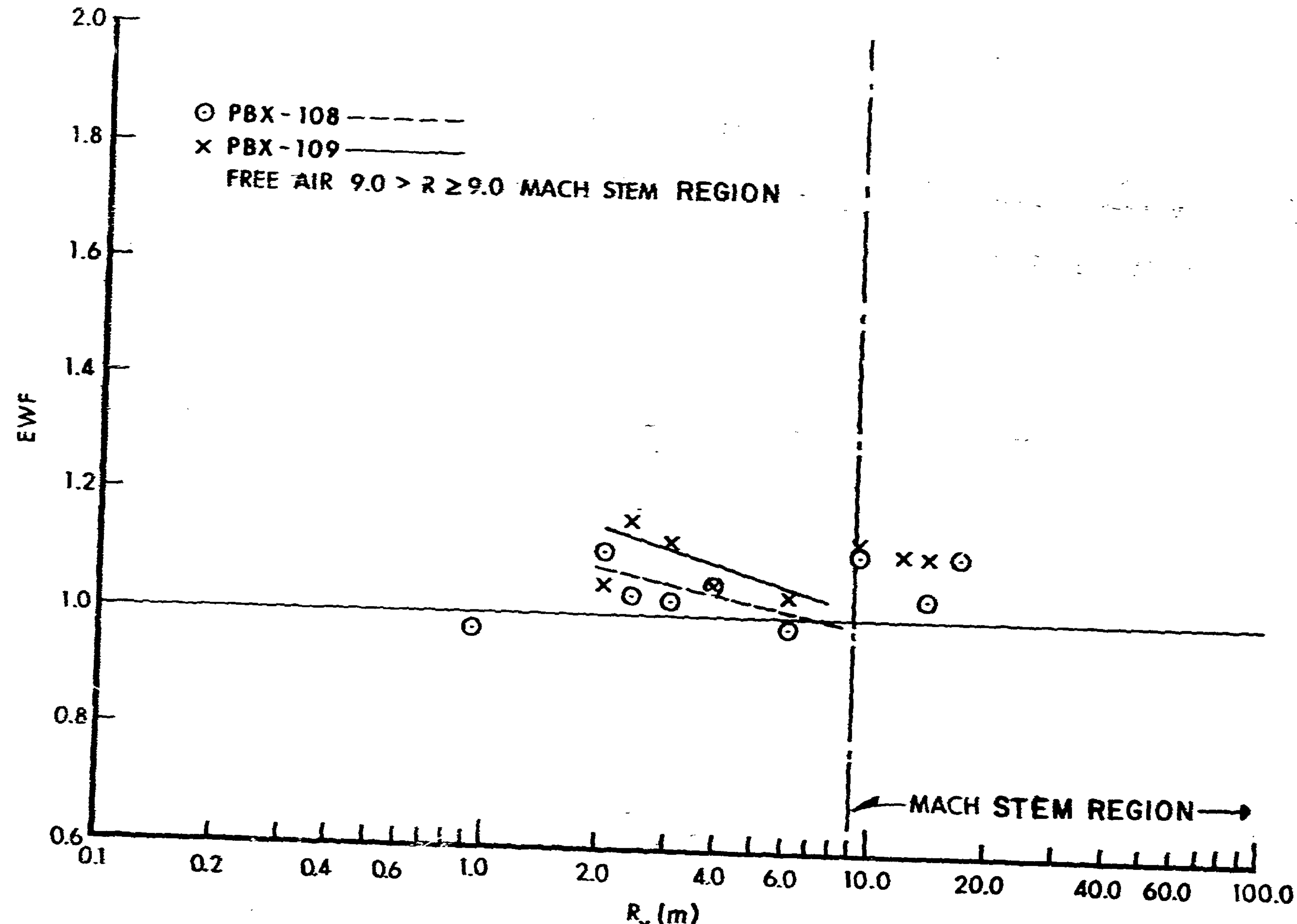

FIGURE 7a. EWF; BASED on PM, R ; versus R_x.

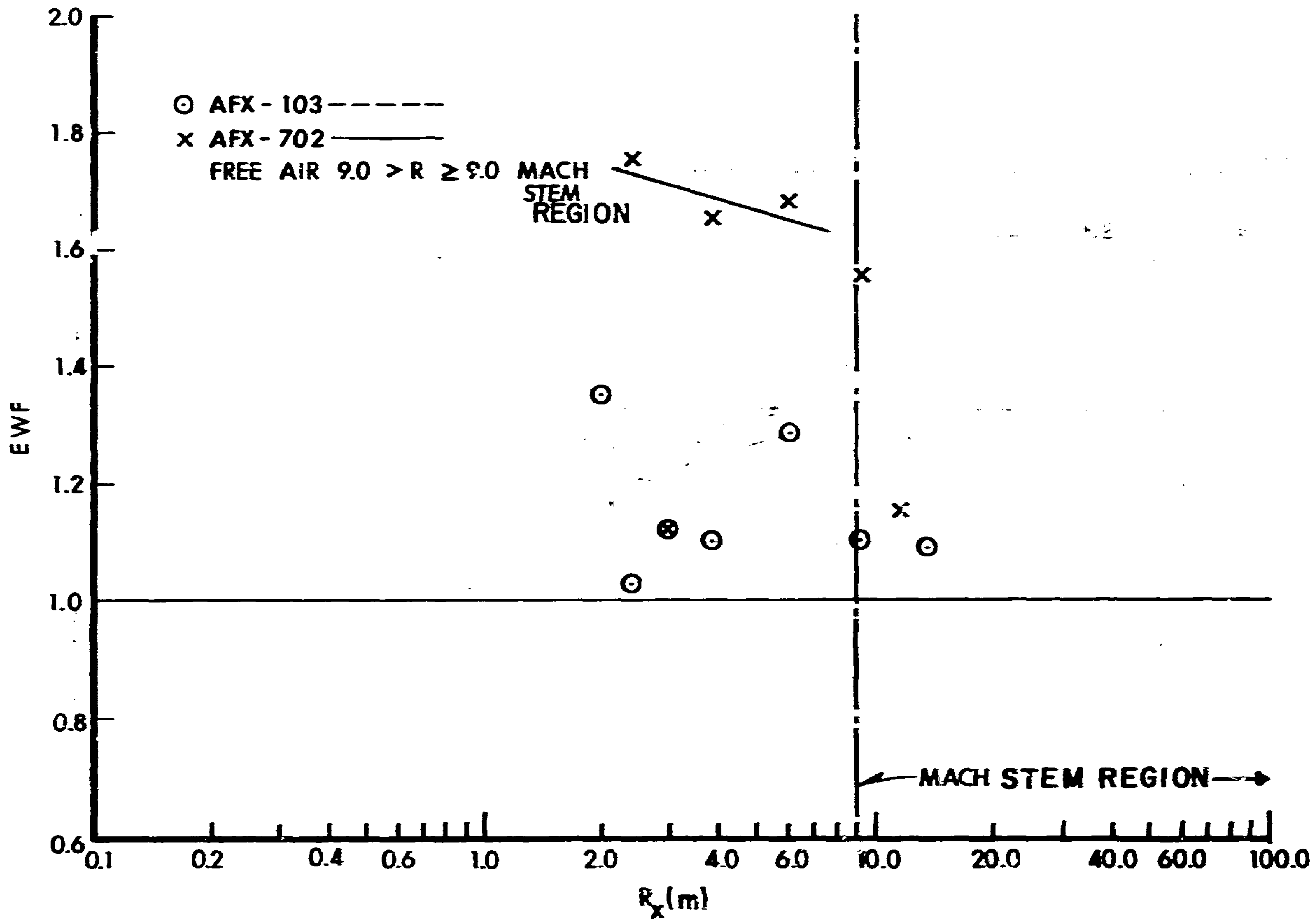

FIGURE 8. EWF; BASED on PM,I; versus R_x.

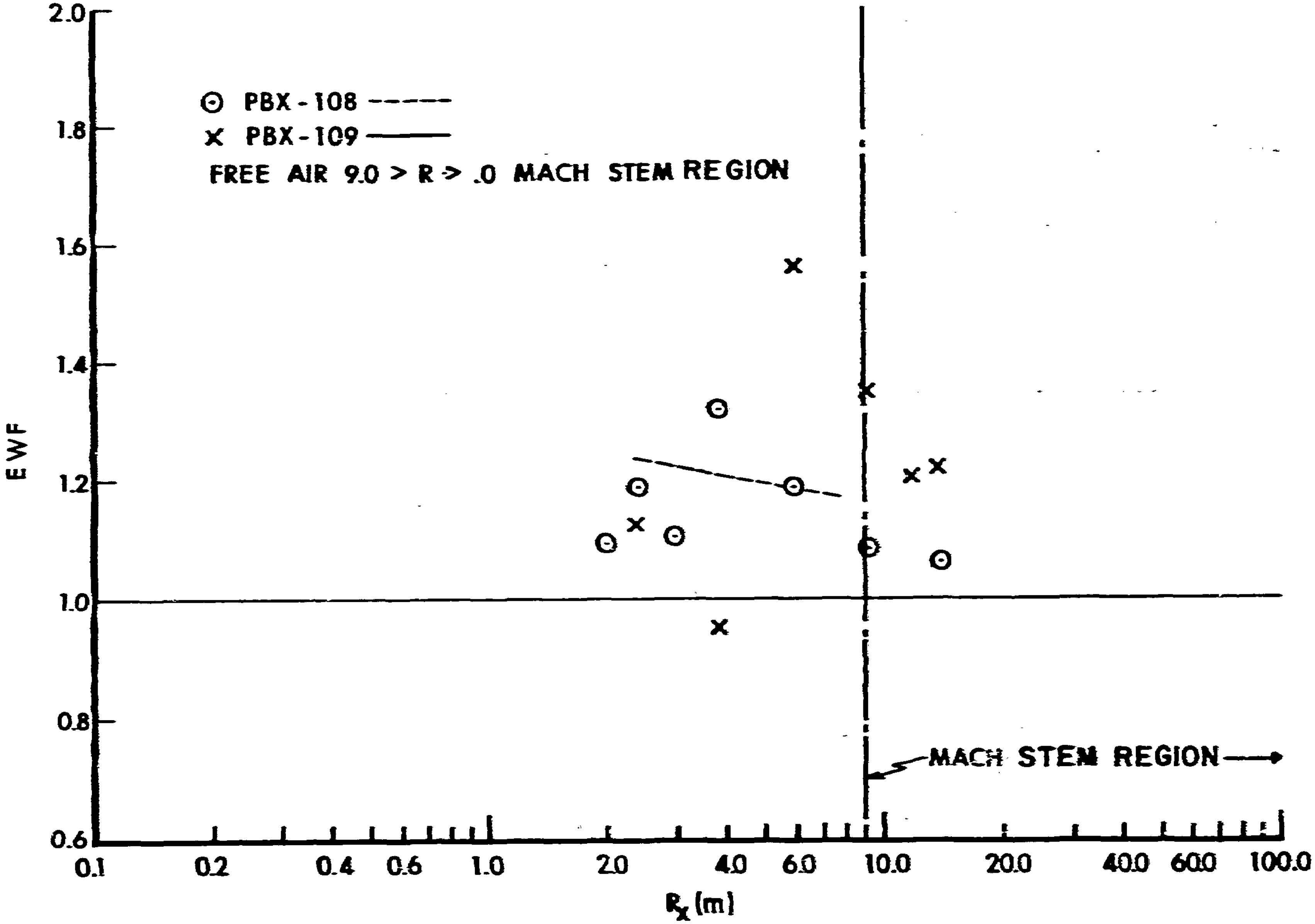

FIGURE 8a. EWF; BASED on P[illegible], I; versus R_x.

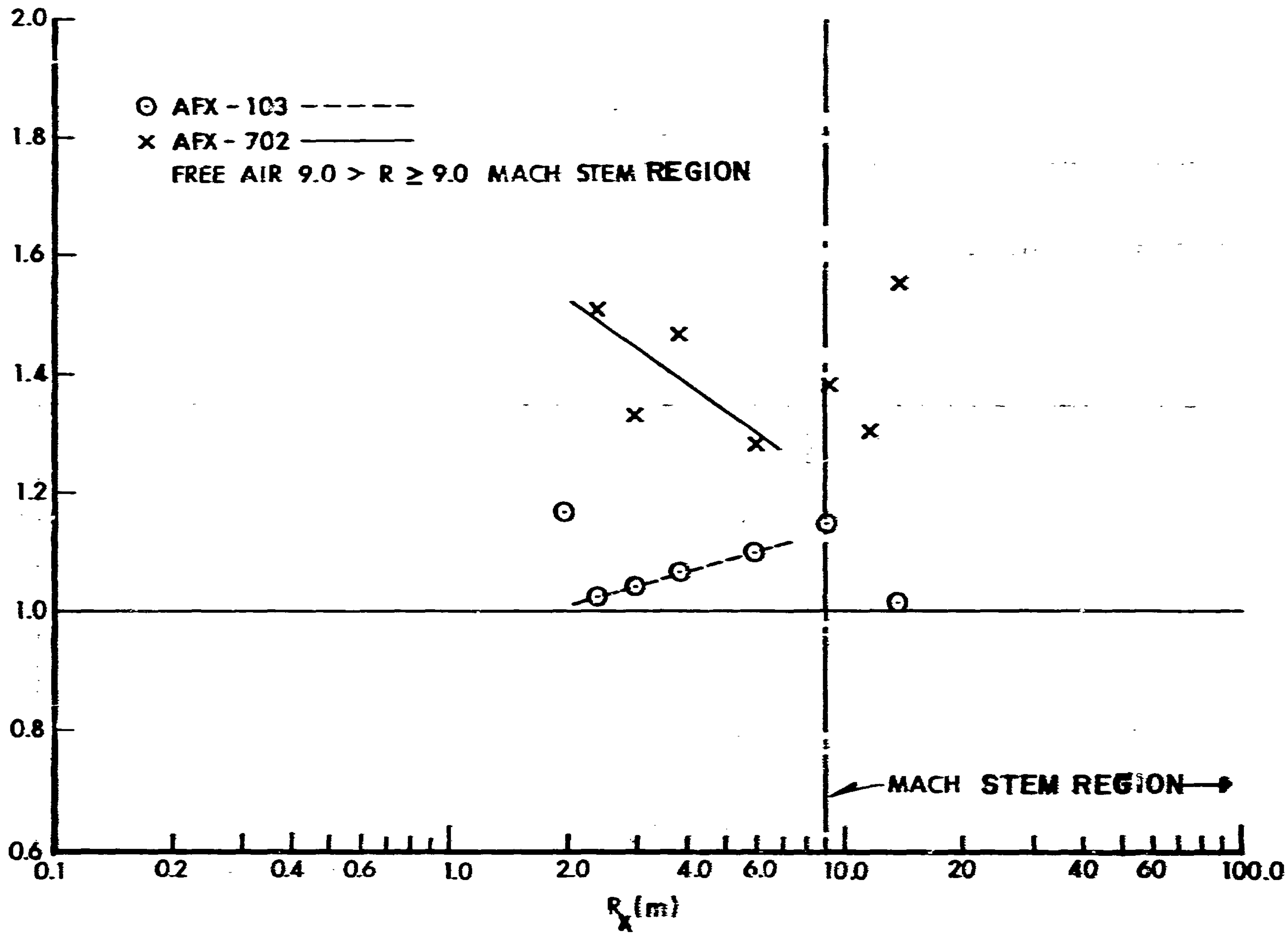

FIGURE 9. EWF; BASED on I, R ; versus R_X.

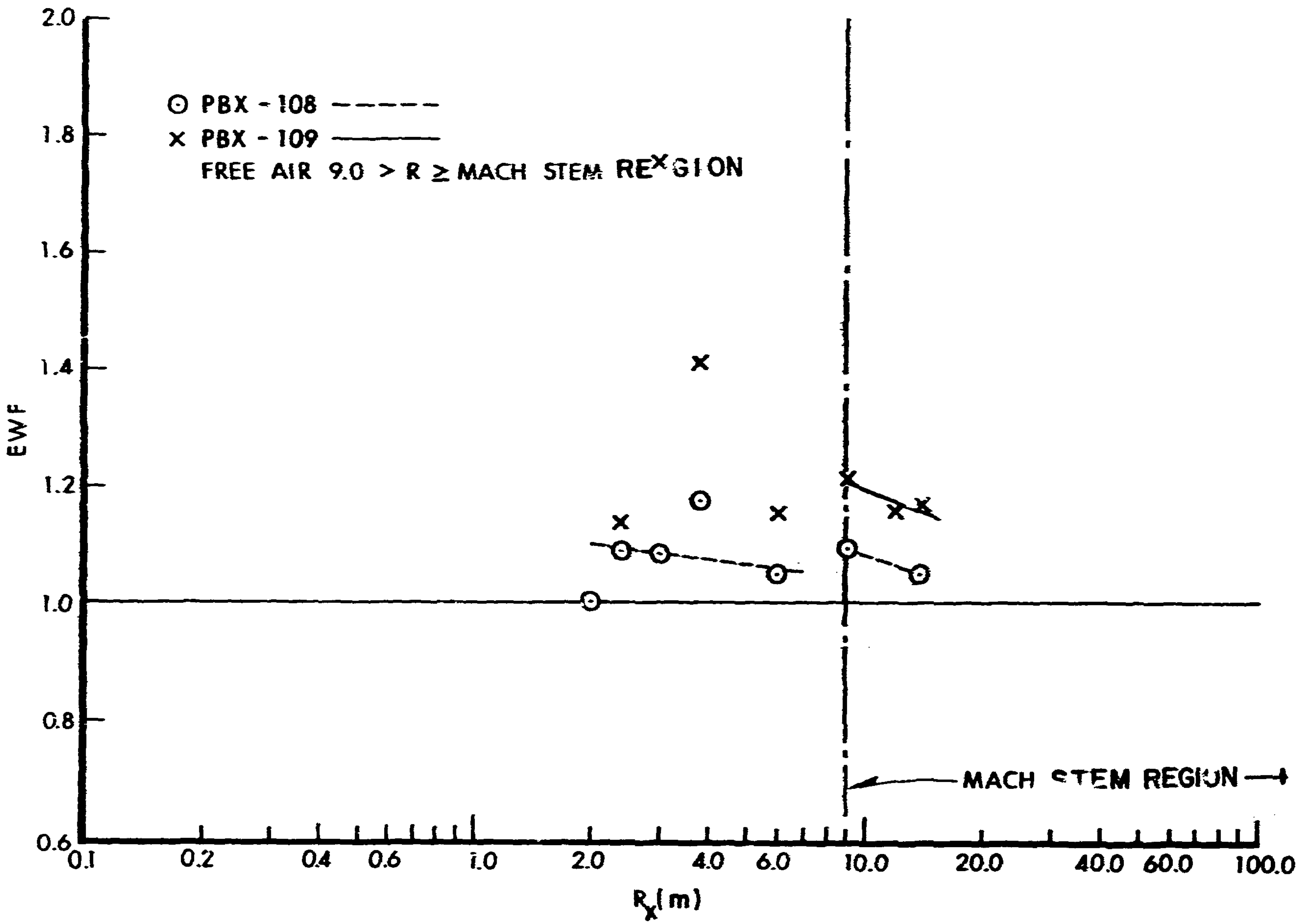

FIGURE 9a. EWF; BASED on I,R; versus R_X.

explosive H-6. The theoretically-based values of PM/P_0 produced by the TAMER Code are presented in Table X as a function of scaled distance, Z, from charge center to gage measurement location. In addition, values of the ratio R/R_0, where R_0 is the charge radius, and empirically-based values of PM/P_0, are included in Table X.
The values for the H-6 explosive are included in Table X to provide a comparison between this standard aluminized explosive and the aluminized test explosive, AFX-702. It can be seen that the theoretical values could be used to obtain reasonable estimates of EWF based on the theoretical pressure distance relationships. This is illustrated in Table XI which presents a comparison of averaged empirically-based values of EWF, from Table VII, and theoretically-based values of EWF derived from TAMER Code theoretical pressure-distance relationships for each of the four test explosives.

Knowledge of certain detonation characteristics, the Chapman Jouguet properties, of explosives is helpful in predicting the damage producing capability and in understanding the operation of explosive damage mechanisms[9]. The dependence of damage effects on these Chapman Jouguet properties varies with the type of weapon involved: for a fragmentation or shaped-charge weapon, fragment velocity or shaped-charge penetration capability primarily depend on detonation pressure, P_d, and for a strictly blast-type weapon, underwater or airblast effects primarily depend on the energy available for air-shock, DQ. There is a direct proportionality between the equivalent weight factor, EWF, and the air-shock energy, DQ. The TAMER Code was used to develop values of DQ and other Chapman Jouguet properties for pentolite, for the AFX-103, AFX-702, and PBX-109 test explosives, and for the standard, H-6 explosive which are presented in Table XII.

VI. CONCLUSIONS

1. The values of equivalent weight factor, EWF, derived from empirical data for each of the four test explosives show considerable scatter. This is not immediately apparent in the listed values in Tables VII through IX, but it is readily seen in the accompanying data plots, Figures 7 through 9. The scatter probably arose from any one or some combination of the following:

a. Chance measurements at or near the extremes of the distribution of the characteristic under consideration.

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[9]*Evan C. Noonan, "Dependence of Damage Effects Upon Detonation Parameters of Organic High Explosives," NAVORD 6703, U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, MD, August 1959.*

Table X. Pressure-Distance Relationships Developed by TAMER Code

EXPLOSIVE	Z $m/kg^{1/3}$	R/R_o	PM/P_o* k Pa	PM/P_o** k Pa
Pentolite (non-aluminized)	0.05248	1.000	81940.	82880.
	0.579	11.02	4763.	3628.
	1.254	23.89	745.8	673.8
	1.495	28.48	453.9	438.7
	1.879	35.77	270.5	256.4
	2.412	45.93	138.8	144.9
	3.796	72.31	53.30	56.84
	5.788	110.2	25.64	27.36
AFX-103 (non-aluminized)	0.05248	1.000	83610.	-
	0.579	10.88	4701.	2634.
	1.254	23.60	710.3	685.0
	1.495	28.13	479.6	470.1
	1.879	35.33	256.4	227.0
	2.412	45.38	131.7	151.0
	3.796	71.43	51.07	59.68
AFX-702 (aluminized)	0.0524	1.000	74980.	-
	0.567	10.82	5263.	4092.
	1.230	23.47	1046.	839.0
	1.464	27.96	594.8	496.5
	1.846	35.23	392.1	233.0
	2.368	45.18	195.6	138.8
	3.693	70.48	71.84	57.14
H-6 (aluminized)	0.0528	1.000	77310.	-
	0.579	11.00	5352.	-
	1.222	23.69	1091.	845.0
	1.492	28.92	642.4	464.1
	1.872	36.3	383.0	265.5
	2.364	45.84	210.06	154.0
	2.983	57.84	113.8	90.58
	3.745	72.6	71.09	60.39

*based on theoretical calculation

**based on empirical

Z = scaled distance

R = distance from center of explosive

R_o = explosive radii

PM = peak excess pressure

P_o = ambient pressure

Table XI. Comparison of Averaged, Empirically- and Theoretically-Based Equivalent Weight Factors, EWF

Explosive	Basis	EWF (Free Air) Empirical[a]	Theoretical[b]
AFX-103	PM, R	1.012	1.00
AFX-702	PM, R	1.127	1.10
PBX-108	PM, R	1.031	1.00
PBX-109	PM, R	1.085	1.10

[a]averaged values from Table VII

[b]averaged values using TAMER Code relationships

PM - peak excess pressure

R - distance from charge center to measurement station

Table XII. Computed Values of Chapman Jouguet Properties[a]

	P_d M Pa	T_d k	$10^{-3}H_d$ J/kg	$10^{-3}E_d$ J/kg	U_d m/s	V_d m/s	A_d m/s	$10^{-3}DQ$ J/kg
Pentolite[b] (non-aluminized)	26346.	2812	12916.	1132.	7800.	2048.	5752	- 5795
AFX-103[b] (non-aluminized)	27403.	2394	15030.	2252.	8157.	2113	6043	- 5526
AFX-702[c] (aluminized)	21674.	3966	11479.	1513.	7419.	1760	5659	- 7656
H-6[c] (aluminized)	23132.	4666	11593.	1616.	7380.	1781.	5598	- 7863.
PBX-109[c] (aluminized)	22955.	3748	12143.	1617.	7604.	1819	5784	- 7907.

[a]detonation properties

[b]non-aluminized explosive

[c]aluminized

P_d = pressure

T_d = temperature

H_d = enthalpy

E_d = internal energy

U_d = wave velocity

V_d = particle velocity

A_d = sound speed

DQ = energy available for air shock

b. Error in measurement reflecting non-functioning or malfunctioning of measuring equipment. The aluminum paint and/or thermal tape used to shield transducers in the gages from extreme fluctuations in temperature did not always provide the desired degree of protection, and errors in recording of explosive characteristic measurement undoubtedly resulted.

c. Normal uncertainty regarding the amount of energy available at an explosive surface. Since EWF is a measure of this energy[10] considerable differences in empirically-based EWF values for a given explosive may be expected.

d. The cube root scaling method of determining values of EWF magnifies errors in the computational basis, the empirical measurements of explosive characteristics in this case, by a factor of three.

Program constraints did not permit extension of testing to confirm suspect observations, i.e., to refine possible errors in characteristic measurement. Additional empirical data would prove very useful for such purpose.

2. The average equivalent weight factor, EWF, values for the four test explosives, relative to pentolite, which are presented in Tables VII through IX reveal that:

a. The test explosives, depending on the EWF basis selected, are from one percent to fifty percent more effective than pentolite.

b. In all cases except one, the aluminized test explosives AFX-702 and PBX-109 are more effective than the non-aluminized test explosives AFX-103 and PBX-108. The exception is in the evaluation in free air with an EWF basis of positive impulse, I, and time of arrival, t_a. In this one evaluation, the aluminized PBX-109 explosive appears slightly less effective than the non-aluminized PBX-108 explosive.

c. Differences in effectiveness between the non-aluminized AFX-103 and PBX-108 explosives are small.

d. The aluminized AFX-702 explosive is, in general, more effective than the aluminized PBX-109 explosive.

e. Both of the aluminized test explosives, AFX-702 and PBX-109, have significantly more target damage producing capability than pentolite. (This observation is supported by the values of EWF in the lower section of Table VII. As noted previously, EWF values based on peak excess pressure, PM, and/or positive impulse, I, are considered a particularly good measure of relative damage-producing effectiveness.)

[10] *Porzel, F. B., "Introduction to A Unified Theory of Explosions (UTE)," NOL, Silver Springs, MD, September 1972.*

3. The values of several explosive characteristics computed by TAMER Code and listed in Tables X and XII reveal that:

a. The non-aluminized explosives, pentolite and AFX-103 have higher pressure, PM/P_o in Table X and P_d in Table XII, at the charge surface, i.e., where $R = R_o$, than do the aluminized explosives, AFX-702, PBX-109, and H-6.

b. The detonation energy available for air shock, DQ in Table XII, is higher for the aluminized than for the non-aluminized explosives.

c. At distances from the charge center of approximately ten charge radii or greater, i.e., where $R > 10\ R_o$, the pressure, PM/P_o in Table X, is higher for the aluminized than for the non-aluminized explosives. (Compare this observation with 3a above.)

It is noted that the TAMER code gives a very good approximation to empirically-determined pressure-distance relationships for the standard pentolite explosive. Empirical data for the test explosives are too meager to determine how good an approximation the code produces for these explosives.

4. During the testing of the aluminized explosives an unusual and unexpected phenomenon, generation of an electromagnetic pulse large enough to have a serious effect on the recording system, was noted. This pulse made it impossible to obtain records at the 3500 and 700 kPa pressure levels. No pulse of similar magnitude was generated during testing of the non-aluminized explosives, and none has been observed in previous testing of the standard aluminized explosive, H-6. It has been stated that detonatable components of mixed explosives do not exert an important influence on the character of the electromagnetic emission where the explosives are detonated[11]. A study is needed to determine the cause of the pulse noted in the tests reported on here.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance of Mr. H. J. Pearce and Mr. B. Pettit in setting up the experiments and Mr. A. Arbuckle for programming the computations of BRLESC.

[11] *Zenin, V. N., et al., "Electromagnetic Radiation Produced in Detonation of Industrial Explosives," Dept. of The Navy, Washington, DC, 1965. (AD 672254).*

APPENDIX

TABULATED VALUES OF BLAST-PARAMETERS MEASUREMENTS FOR AFX-103, AFX-702, PBX-108, PBX-109 AND PENTOLITE EXPLOSIVES AND GRAPHIC PRESENTATION OF PENTOLITE DATA

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
0.3650	7616.639	0.0000	0.00	0.0000	0
0.4205	6221.140	0.0000	0.00	0.0000	0
0.4245	5673.696	0.0000	0.00	0.0000	0
0.4721	5155.211	0.0000	0.00	0.0000	1
0.5197	4101.692	0.0000	0.00	0.0000	0
0.5848	3400.495	0.2046	0.21	200.4029	0
0.5854	3639.743	0.2049	0.00	143.9142	0
0.5854	2972.330	0.2049	0.00	145.3463	0
0.5854	3058.515	0.2049	0.00	0.0000	0
0.5854	2920.610	0.2049	0.00	0.0000	0
0.5854	3258.463	0.2049	0.00	0.0000	0
0.5854	3430.832	0.2305	0.00	0.0000	0
0.5854	0.000	0.2305	0.00	0.0000	0
0.5854	0.000	0.2049	0.00	0.0000	0
0.5854	0.000	0.2049	0.00	0.0000	0
0.5854	0.000	0.2049	0.00	0.0000	0
0.5871	0.000	0.0000	0.16	0.0000	0
0.5890	3270.184	0.2061	0.00	161.3465	0
0.5890	3275.700	0.2061	0.23	201.1392	0
0.5895	2850.982	0.1753	0.14	183.3453	0
0.5950	3161.247	0.0000	0.00	147.0794	0
0.5990	0.000	0.0000	0.23	0.0000	0
0.6307	3011.630	0.0000	0.00	0.0000	0
0.7379	2267.686	0.0000	0.00	0.0000	0
0.7974	1827.800	0.0000	0.00	155.0655	0
0.7974	0.000	0.0000	0.39	0.0000	0
0.8450	1716.105	0.0000	0.00	0.0000	0
0.9521	1385.157	0.0000	0.00	0.0000	0
0.9798	1214.856	0.0000	0.00	130.0295	0
0.9838	0.000	0.0000	0.42	0.0001	0
0.9907	1176.246	0.0000	0.00	131.9157	0
0.9907	0.000	0.0000	0.68	1.0001	0
1.0552	1054.898	0.0000	0.00	0.0001	0
1.1663	861.845	0.0000	0.00	0.0000	0
1.1703	786.002	0.0000	0.00	146.0045	0
1.1901	748.771	0.0000	0.00	128.9543	0
1.1941	0.000	0.0000	0.50	0.0000	0
1.2530	750.305	0.8075	1.04	131.3458	0
1.2670	709.471	0.7572	0.89	149.3289	0
1.2695	580.539	0.7939	0.84	140.1619	0
1.2685	692.234	0.7696	1.19	135.4382	0
1.2685	594.811	0.7888	0.94	105.4103	0
1.2685	771.523	0.7914	1.22	119.0801	0
1.2685	423.614	0.7965	0.98	114.6809	0
1.2685	852.882	0.7837	0.90	117.0737	0
1.2685	827.371	0.7930	1.03	123.0334	0
1.2685	657.967	0.7696	0.90	121.2234	0
1.2685	630.112	0.7939	0.88	121.6207	0
1.2685	640.937	0.7939	0.84	119.4576	0
1.2685	577.574	0.7930	0.83	128.0218	0

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
1.2685	630.801	0.7171	0.00	0.0000	0
1.2685	603.420	0.7427	0.00	0.0000	0
1.2685	560.544	0.7939	0.00	0.0000	0
1.2685	476.841	0.7939	0.00	0.0000	0
1.2685	553.373	0.7939	0.00	0.0000	0
1.2685	626.871	0.7862	0.00	0.0000	0
1.2685	518.270	0.8195	0.00	0.0000	0
1.2685	645.074	0.7939	0.00	0.0000	0
1.2685	621.011	0.7747	0.00	0.0000	0
1.2685	628.181	0.7747	0.00	0.0000	0
1.2685	560.024	0.7747	0.00	0.0000	0
1.2685	703.265	0.7645	0.00	0.0000	0
1.2685	629.560	0.7683	0.00	0.0000	0
1.2685	709.471	0.7683	0.00	0.0000	0
1.2685	688.477	0.7683	0.00	0.0000	0
1.2685	810.134	0.7683	0.00	0.0000	0
1.2685	0.000	0.7427	0.00	0.0000	0
1.2685	0.000	0.7427	0.00	0.0000	0
1.2685	0.000	0.7427	0.00	0.0000	0
1.2685	0.000	0.7683	0.00	0.0000	0
1.2685	0.000	0.7683	0.00	0.0000	0
1.2685	0.000	0.7683	0.00	0.0000	0
1.2761	785.313	0.7794	0.93	107.3847	0
1.2761	765.318	0.7742	1.08	113.6044	0
1.2771	714.297	0.7439	1.06	119.6290	0
1.2774	706.023	0.0000	0.00	144.0277	0
1.2778	0.000	0.0000	0.71	0.0000	0
1.3646	545.858	0.0000	0.00	103.0207	0
1.3646	582.331	0.0000	0.00	125.3921	0
1.3646	0.000	0.0000	0.84	0.0000	0
1.3805	548.685	0.0000	0.00	0.0001	0
1.4400	463.190	0.0000	0.00	113.0671	0
1.4440	0.000	0.0000	0.92	1.0000	0
1.4550	0.000	0.0000	0.75	0.0000	0
1.4876	453.468	0.0000	0.00	0.0000	0
1.5106	439.334	1.0035	0.93	112.9340	0
1.5124	447.125	1.1320	1.25	114.3357	0
1.5124	462.500	1.1115	1.13	116.8023	0
1.5124	478.280	1.0670	1.09	115.0431	0
1.5124	457.467	1.0897	1.09	113.1006	0
1.5124	445.263	0.9603	1.09	100.8262	0
1.5124	426.234	1.0807	1.13	118.4904	0
1.5124	446.542	1.0756	1.08	110.0545	0
1.5124	425.269	1.0756	1.07	117.2203	0
1.5124	402.585	1.0756	0.86	102.6523	0
1.5124	437.334	1.0244	1.08	111.1582	0
1.5124	490.976	1.0500	1.04	107.6707	0
1.5124	461.604	1.0756	1.02	113.2121	0
1.5124	0.000	1.0756	1.08	110.3195	0
1.5124	0.000	0.9988	1.07	115.9253	0

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
1.5124	0.000	1.0756	1.07	112.7475	0
1.5124	0.000	1.1012	0.80	104.5406	0
1.5215	419.822	1.0976	1.27	128.4822	0
1.5215	460.156	1.0989	1.13	112.4941	0
1.5227	448.159	0.9038	1.23	141.5648	0
1.5706	380.666	1.2625	1.14	101.7967	0
1.5987	406.653	0.0000	0.00	140.0795	0
1.5987	412.169	0.0000	0.00	104.9941	0
1.5987	0.000	0.0000	0.07	0.0000	0
1.6023	0.000	0.0000	1.00	0.0000	0
1.6146	379.074	0.0000	0.00	0.0001	0
1.6265	421.752	0.0000	0.00	117.9164	0
1.6304	0.000	0.0000	1.20	0.0001	0
1.6970	341.842	0.0000	0.00	0.0001	0
1.7455	320.468	0.0000	0.00	110.0907	0
1.7558	0.000	0.0000	1.14	0.0000	0
1.8615	261.863	0.0000	0.00	92.1615	0
1.9004	258.967	1.7612	1.35	102.4722	0
1.9027	249.728	1.8030	1.47	104.4481	0
1.9027	267.517	1.7415	1.63	109.8701	0
1.9027	234.835	1.7960	1.40	97.2083	0
1.9027	227.827	1.7940	1.52	94.7361	0
1.9027	198.776	1.6685	1.38	84.6264	0
1.9027	237.249	1.7697	1.54	55.6344	0
1.9027	234.904	1.7997	1.50	91.4252	0
1.9027	224.838	1.7671	1.30	93.1010	0
1.9027	220.425	1.7671	1.43	90.5864	0
1.9027	236.835	1.7671	1.57	98.0209	0
1.9027	240.075	1.7415	1.38	94.3588	0
1.9027	206.877	1.8439	1.40	90.6787	0
1.9027	212.152	1.8183	1.48	70.8055	0
1.9027	207.050	1.7415	1.50	87.3534	0
1.9027	221.322	1.8183	1.41	90.0455	0
1.9027	0.000	1.8183	1.45	90.1009	0
1.9121	250.142	0.0000	0.00	0.0000	0
1.9142	241.041	1.6425	1.44	95.1735	0
1.9142	253.658	1.7468	1.46	102.8124	0
1.9157	251.176	1.6528	1.28	93.5172	0
1.9215	225.111	1.8713	1.39	87.0945	0
1.9478	227.596	0.0000	0.00	91.4435	0
1.9557	218.358	0.0000	0.00	49.8412	0
1.9557	251.038	0.0000	0.00	130.0559	0
1.9557	0.000	0.0000	1.13	0.0000	0
1.9676	180.537	0.0000	0.00	35.6613	0
1.9676	0.000	0.0000	1.55	0.0001	0
1.9756	217.736	0.0000	0.00	94.5844	0
1.9756	0.000	0.0000	1.48	0.0000	0
1.9796	246.074	0.0000	0.00	105.0812	0
1.9835	0.000	0.0000	1.42	0.0001	0
1.9964	211.831	0.0000	0.00	98.2637	0

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
1.9994	0.000	0.0000	1.34	0.0000	0
2.0073	202.868	0.0000	0.00	88.3027	0
2.0113	0.000	0.0000	1.48	0.0001	0
2.0192	220.081	0.0000	0.00	90.4644	0
2.0232	212.970	0.0000	0.00	85.7010	0
2.0232	0.000	0.0000	1.38	0.0003	0
2.0271	0.000	0.0000	1.42	0.0000	0
2.2334	166.095	0.0000	0.00	107.0565	0
2.2374	167.474	0.0000	0.00	47.1361	0
2.2374	0.000	0.0000	1.52	0.0000	0
2.2413	0.000	0.0000	1.52	0.0000	0
2.3683	132.241	0.0000	0.00	84.1748	0
2.3719	0.000	0.0000	1.90	0.0003	0
2.3723	144.790	0.0000	0.00	80.8544	0
2.3762	0.000	0.0000	1.60	0.0003	0
2.3961	133.620	0.0000	0.00	92.6907	0
2.4258	129.766	2.8063	1.83	73.0221	0
2.4365	167.129	2.7754	1.78	95.3201	0
2.4394	151.202	2.7063	1.72	85.7746	0
2.4394	150.857	2.7650	1.72	87.5401	0
2.4394	164.925	2.7966	1.82	80.4424	0
2.4394	157.338	2.8312	1.84	87.8051	0
2.4394	152.374	2.8158	1.82	87.8846	0
2.4394	152.026	2.7902	1.77	80.2912	0
2.4394	138.413	2.8427	1.84	70.8150	0
2.4394	138.276	2.8171	1.82	70.7704	0
2.4394	134.034	2.8171	1.78	74.0034	0
2.4394	144.097	2.8427	1.79	88.0836	0
2.4394	134.379	2.8427	1.70	78.6240	0
2.4394	134.034	2.8171	1.86	83.6566	0
2.4394	142.584	2.7015	1.76	72.1088	0
2.4394	146.307	2.8427	1.81	88.7458	0
2.1394	153.477	2.8683	1.82	91.2486	0
2.4394	150.710	2.8683	1.80	80.7019	0
2.4478	124.657	0.0000	0.00	73.0446	0
2.4541	154.904	2.6241	1.77	82.3831	0
2.4541	148.308	2.8057	1.77	84.2444	0
2.4860	162.027	2.8888	1.68	85.1165	0
2.5270	126.657	0.0000	0.00	76.0993	0
2.5424	0.000	0.0000	1.84	0.0003	0
2.5627	128.174	0.0000	0.00	90.0667	0
2.5627	0.000	0.0003	1.65	0.0000	0
2.5788	125.347	0.0000	0.00	75.8893	0
2.5788	0.000	0.0000	1.69	0.0000	0
2.6261	129.553	0.0000	0.00	92.2003	0
2.6301	0.000	0.0000	1.74	0.0003	0
2.6817	0.000	0.0000	1.14	0.0003	0
2.8404	99.147	0.0000	0.00	72.0601	0
2.8443	0.000	0.0000	2.21	0.0001	0
2.8800	97.837	0.0000	0.00	67.0121	0

*0 - Free Air
1 - Mach Stem

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Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
2.8844	0.000	0.0000	2.10	0.0000	0
2.9514	107.489	0.0000	0.00	70.1755	0
2.9584	0.000	0.0000	1.86	0.0000	0
2.9594	92.321	0.0000	0.00	71.3421	0
2.9633	0.000	0.0000	1.01	0.0001	0
3.0611	77.839	4.2309	2.17	61.0663	0
3.2053	77.152	0.0000	0.00	61.2017	0
3.2089	0.000	0.0000	2.28	0.0000	0
3.2172	75.531	0.0000	0.00	58.0942	0
3.2912	0.000	0.0000	2.04	0.0000	0
3.2986	0.000	0.0000	1.38	0.0000	0
3.3362	72.526	0.0000	0.00	51.4704	0
3.3402	0.000	0.0000	2.37	0.0000	0
3.3442	0.000	0.0000	2.50	0.0001	0
3.4156	0.000	0.0000	1.55	0.0000	0
3.4195	63.363	0.0000	0.00	53.7534	0
3.4552	66.258	0.0000	0.00	56.6552	0
3.4590	0.000	0.0000	2.45	0.0000	0
3.4751	60.534	0.0000	0.00	61.4451	0
3.4790	0.000	0.0000	2.38	0.0000	0
3.5068	65.638	0.0000	0.00	55.4558	0
3.7607	59.846	0.0000	0.00	54.4715	0
3.7643	0.000	0.0000	2.26	0.0000	0
3.7805	60.674	0.0000	0.00	53.2151	0
3.7809	0.000	0.0000	2.03	0.0000	0
3.7924	58.968	0.0000	0.00	55.6170	0
3.7964	0.000	0.0000	2.60	0.0000	0
3.8340	57.020	6.0509	2.88	12.3643	0
3.8386	60.116	6.0632	3.71	50.0405	0
3.8386	69.802	6.0610	2.80	55.5701	0
3.8386	59.605	6.0868	2.50	56.6165	0
3.8386	60.040	6.0091	2.55	55.7115	0
3.8386	64.007	6.0363	2.52	55.1377	0
3.8386	54.148	6.0350	2.53	57.0159	0
3.8386	54.172	6.1464	2.54	52.0014	0
3.8386	56.155	6.0898	2.62	53.1073	0
3.8386	60.033	6.0606	2.46	51.4482	0
3.8386	56.123	6.1208	2.61	54.0141	0
3.8386	55.517	6.0184	2.52	53.7261	0
3.8386	56.468	6.1076	2.50	52.0016	0
3.8386	52.531	6.0091	2.58	52.1709	0
3.8386	57.702	6.1464	2.62	55.0062	0
3.8386	0.000	6.1076	2.66	55.7260	0
3.8386	0.000	6.1076	2.61	55.8442	0
3.8430	52.886	6.1765	2.58	49.8857	0
3.8510	62.040	0.0000	0.00	50.0483	0
3.8510	0.000	0.0000	2.32	0.0000	0
3.8617	60.660	5.8318	2.52	55.1583	0
3.8617	61.832	6.0276	2.54	20.6224	0
3.8648	61.239	5.7914	2.47	55.4703	0

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
3.9038	53.228	0.0000	0.00	48.0072	0
3.9008	58.434	0.0000	0.00	40.7459	0
3.9008	0.000	0.0000	2.80	0.0000	0
4.1987	0.000	0.0000	2.24	0.0000	0
4.3637	0.000	0.0000	2.07	0.0000	0
4.4271	42.472	0.0000	0.00	45.0461	0
4.4311	0.000	0.0000	2.77	0.0001	0
4.4828	38.817	0.0000	0.00	46.7534	0
4.4828	0.000	0.0000	3.03	0.0000	0
4.6136	30.921	0.0000	0.00	43.6760	0
4.6136	0.000	0.0000	2.88	0.0001	0
4.6069	47.910	0.0000	0.00	46.8640	0
4.6060	0.000	0.0000	2.42	0.0009	0
4.8838	36.473	0.0000	0.00	41.0074	0
4.8838	0.000	0.0000	2.04	0.0000	0
5.3237	33.846	0.0000	0.00	48.3184	0
5.3237	0.000	0.0000	2.86	0.0000	0
5.3396	31.409	0.0000	0.00	30.2187	0
5.3396	0.000	0.0000	2.48	0.0000	0
5.3584	0.000	0.0000	2.47	0.0001	0
5.3061	0.000	0.0000	2.03	0.0009	0
5.5370	30.820	0.0000	0.00	14.0081	0
5.5370	0.000	0.0000	2.06	0.0001	0
5.7601	27.234	0.0000	0.00	15.8067	0
5.7640	0.000	0.0000	3.16	0.0001	0
5.8318	25.786	0.0000	0.00	11.0469	0
5.8848	57.481	11.9407	4.23	60.4408	1
5.8848	57.027	11.9407	4.23	60.1824	1
5.8848	62.363	12.0240	4.23	75.0014	1
5.8848	63.783	11.8809	4.35	75.0473	1
5.8848	61.820	12.1820	4.23	75.0473	1
5.8848	61.777	12.0816	4.23	75.0031	1
5.8848	54.234	12.1984	4.23	65.9074	1
5.8848	56.682	12.1456	4.35	64.6948	1
5.8848	55.013	12.0111	4.23	68.2023	1
5.8848	57.887	12.0624	4.23	65.1145	1
5.8848	56.261	12.0368	4.23	66.7470	1
5.8848	57.089	12.0111	4.23	65.7767	1
5.8848	56.304	12.0624	4.23	64.6283	1
5.8848	56.809	12.0624	4.23	68.2443	1
5.8848	56.606	11.9343	4.10	67.0129	1
5.8848	56.261	12.0111	4.10	66.7634	1
5.8848	62.453	11.9343	4.23	60.7040	1
5.8848	61.856	12.0624	4.23	71.8644	1
5.8848	61.867	12.1136	4.10	74.2825	1
5.8848	59.888	12.1648	4.10	72.3955	1
5.8842	52.073	12.1562	3.10	60.8382	1
5.8711	26.800	0.0000	0.00	40.6515	0
5.8751	0.000	0.0000	3.16	0.0003	0
5.9227	27.924	0.0000	0.00	10.4721	0

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
6.0227	0.000	0.0000	4.32	0.0001	0
6.7430	0.000	0.0000	2.80	0.0000	0
6.9025	0.000	0.0000	2.53	0.0000	0
7.4157	41.180	15.8783	4.61	58.8[illegible]	1
7.4157	41.741	15.8783	4.61	58.2274	1
7.4157	39.369	16.0191	4.61	54.4755	1
7.4157	36.066	15.8527	4.41	49.5743	1
7.4157	30.337	16.1728	4.61	43.3067	1
7.4157	0.000	16.0980	4.35	0.0001	1
7.4157	0.000	16.1600	4.35	0.0000	1
7.4157	0.000	16.1664	4.35	0.0000	1
7.4157	0.000	16.0447	4.48	0.0001	1
7.4157	0.000	16.0310	4.23	0.0000	1
7.4157	38.650	16.0063	4.61	54.5195	1
7.4157	41.996	15.6042	4.48	58.8811	1
7.4157	0.000	16.0575	4.23	0.0000	1
7.4157	40.121	15.9030	2.75	41.7615	1
7.4157	0.000	16.0191	3.07	0.0001	1
7.4157	0.000	15.9295	4.48	0.0001	1
7.4157	0.000	16.0832	4.74	0.0000	1
7.4157	0.000	16.1344	4.23	0.0000	1
7.4157	0.000	16.1886	4.87	0.0000	1
7.4280	37.632	16.0489	3.46	43.3464	1
7.6288	16.203	0.0000	0.00	24.0476	0
7.6288	0.000	0.0000	3.63	0.0001	0
7.6801	17.306	0.0000	0.00	28.6265	0
7.6801	0.000	0.0000	3.85	0.0000	0
7.7713	18.547	0.0000	0.00	24.6791	0
7.9498	16.410	0.0000	0.00	29.6147	0
7.9498	0.000	0.0000	3.85	0.0000	0
8.0133	0.000	0.0000	3.62	0.0000	0
8.0212	16.823	0.0000	0.00	26.0242	0
8.1740	16.203	0.0000	0.00	26.0242	0
8.7817	31.316	19.4381	4.87	49.3105	1
8.7817	32.240	19.4381	4.87	49.1330	1
8.7817	34.060	19.6045	4.87	53.6367	1
8.7817	34.943	19.4253	4.87	53.1511	1
8.7817	33.715	19.7774	4.87	54.2080	1
8.7817	34.483	19.7006	4.87	53.2457	1
8.7817	33.806	19.7902	4.99	48.6041	1
8.7817	30.406	19.7068	4.99	47.4122	1
8.7817	30.447	19.5807	4.87	47.8035	1
8.7817	29.834	19.6558	4.87	49.1339	1
8.7817	31.799	19.6430	4.87	49.0807	1
8.7817	29.092	19.5917	4.99	45.8101	1
8.7817	30.723	19.6686	4.74	47.5645	1
8.7817	31.302	19.6686	4.87	47.8074	1
8.7817	30.778	19.4893	4.87	50.6343	1
8.7817	32.388	19.6174	4.87	50.1034	1
8.7817	32.488	19.5149	4.74	41.5401	1

*0 - Free Air
1 - Mach Stem

Table A-I. Scaled Measured Blast Properties of Spherical Pentolite (Cont'd)

Z (M/KG**1/3)	PM (KPA)	TA (MS/KG**1/3)	TD (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)	*
8.7817	27.370	19.6942	4.61	0.0000	1
8.7817	0.000	19.7710	0.00	0.0000	1
8.7817	0.000	19.8222	0.00	0.0000	1
8.7964	30.630	19.8048	3.74	42.6150	1
10.0087	9.653	0.0000	0.00	20.4604	0
10.0087	0.000	0.0000	4.22	0.0000	0
10.5381	24.221	24.1439	4.09	41.0994	1
10.5381	24.538	24.1696	4.09	40.8787	1
10.5557	21.720	24.2834	4.20	34.6865	1
10.5918	0.000	0.0000	3.35	0.0000	0
11.5280	10.549	0.0000	0.00	19.0221	0
11.5320	0.000	0.0000	4.31	0.0000	0
11.5796	9.097	0.0000	0.00	17.4997	0
11.5796	0.000	0.0000	4.01	0.0000	0
13.6464	8.067	0.0000	0.00	15.5249	0
13.6464	0.000	0.0000	4.18	0.0000	0
16.1090	6.626	0.0000	0.00	12.9224	0
16.1090	0.000	0.0000	4.36	0.0000	0
16.1575	0.000	0.0000	4.50	0.0000	0
16.1615	6.688	0.0000	0.00	13.4603	0
17.8514	6.391	0.0000	0.00	13.0121	0
26.9754	3.792	0.0000	0.00	8.6149	0

*0 - Free Air
1 - Mach Stem

Table A-II. Measured Blast Properties of Spherical AFX-103

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
.9144	3193.	-	.3080	-
.9144	2137.	230.0	.3600	.350
.9144	2100.	-	.3600	-
.9144	3057.	-	.3200	-
.9144	2689.	-	.3200	-
1.982	762.6	188.3	1.206	1.550
1.982	641.6	209.6	1.160	1.490
1.982	655.0	156.9	1.120	.970
1.982	682.2	209.2	1.200	1.330
1.982	662.0	220.2	1.200	1.550
1.982	658.7	-	1.184	-
1.982	672.7	-	1.120	-
1.982	-	-	1.120	-
1.982	645.1	-	1.160	-
1.982	-	-	1.120	-
2.362	466.6	185.0	1.666	1.910
2.362	468.8	184.2	1.600	1.910
2.362	460.0	173.6	1.640	1.630
2.362	486.8	168.5	1.680	1.590
2.362	-	-	1.600	-
2.971	262.9	169.0	2.752	2.230
2.971	206.8	150.3	2.800	2.470
2.971	215.9	146.2	2.840	2.570
2.971	224.2	149.6	2.840	2.270
2.971	223.0	157.5	2.80	2.430
3.810	157.0	142.2	4.320	2.810
3.810	156.0	137.1	4.320	2.910
3.810	135.7	132.7	4.328	2.850
3.810	154.0	142.1	4.400	2.850
3.810	155.3	146.2	4.420	3.050
5.995	60.70	92.80	9.442	4.110
5.995	60.67	82.74	9.520	4.010
5.995	57.52	91.29	9.480	3.170
5.995	59.61	161.3	9.640	4.370
5.995	59.99	-	9.642	5.600
9.144	-	-	18.54	6.800
9.144	61.36	114.6	18.40	6.600
9.144	63.08	112.1	18.44	6.600
9.144	65.08	118.8	18.76	6.400
9.144	68.86	129.4	18.52	6.400
11.58	-	-	24.76	7.200
11.58	34.47	62.47	24.56	6.400
11.58	29.41	56.33	24.60	6.800
11.58	32.82	62.2	25.00	7.200
11.58	27.66	63.22	24.76	7.200

Table A-II. Measured Blast Properties of Spherical AFX-103 (Cont'd)

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
13.72	32.25	81.91	30.36	7.600
13.72	31.48	77.50	30.16	7.600
13.72	28.23	68.05	30.16	7.600
13.72	28.02	73.22	30.64	7.400
13.72	-	-	30.40	-

Table A-III. Measured Blast Properties of Spherical AFX-702

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
.9144	4120.	-	.3380	-
.9144	40679.	-	.3340	-
1.981	795.0	-	1.208	-
1.981	883.9	-	1.204	-
2.362	503.0	218.2	1.678	3.390
2.362	490.2	227.5	1.734	3.410
2.972	254.1	165.3	2.758	2.190
2.972	285.6	224.4	2.720	3.970
2.972	-	-	2.880	-
2.972	-	-	2.880	-
2.972	232.9	154.7	2.920	2.370
2.972	209.0	108.9	2.920	1.510
3.810	155.1	165.1	4.326	4.310
3.810	166.0	174.0	4.270	4.250
3.810	151.	128.1	4.400	2.610
3.810	-	-	4.520	-
3.810	154.8	155.9	4.560	4.190
3.810	-	-	4.480	-
5.995	60.67	118.3	9.428	5.800
5.995	61.27	98.73	9.336	5.200
5.995	-	-	9.640	-
5.995	-	-	9.640	-
5.995	59.65	104.6	9.720	5.400
5.995	-	-	9.760	-
9.144	67.79	140.0	18.55	6.400
9.144	66.76	143.8	18.64	6.800
9.144	57.23	92.25	18.44	5.200
9.144	63.07	127.4	18.72	6.400
9.144	68.04	138.5	18.72	6.200
9.144	-	-	18.92	6.200
11.58	-	-	24.74	6.200
11.58	-	-	24.84	-
11.58	51.64	107.9	24.60	7.600
11.58	51.64	-	24.96	6.000
11.58	-	-	24.96	-
11.58	-	-	25.16	-
13.72	35.95	100.2	30.32	7.600
13.72	38.51	108.2	30.40	-
13.72	-	-	30.56	-
13.72	-	-	30.52	-
13.72	-	-	30.80	-

Table A-IV. Measured Blast Properties of Spherical PBX-108

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
.9144	3351.	313.1	0.302	.310
.9144	3118.	225.5	0.330	.250
.9144	3020.	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	0.320	-
.9144	-	-	-	-
1.981	-	-	1.222	-
1.981	709.5	185.1	1.208	-
1.981	600.3	190.4	1.160	1.650
1.981	666.0	201.6	1.160	1.790
1.981	600.5	201.8	1.280	1.290
1.981	574.2	-	1.120	-
1.981	696.3	176.5	1.160	1.310
1.981	503.3	185.1	1.280	1.250
1.981	747.4	190.4	1.120	-
1.981	-	201.6	1.160	-
1.981	-	-	1.120	-
2.362	471.1	207.2	1.710	1.790
2.362	511.4	189.0	1.626	1.730
2.362	430.6	168.2	1.640	1.690
2.362	440.0	173.4	1.680	1.570
2.362	482.8	174.1	1.560	1.810
2.362	499.1	160.2	1.680	1.350
2.971	259.6	155.0	2.566	2.210
2.971	272.3	165.1	2.694	2.270
2.971	227.8	143.3	2.760	2.130
2.971	218.3	140.2	2.800	2.230
2.971	221.1	139.7	2.640	2.330
2.971	226.3	154.2	2.720	2.470
3.810	168.0	132.3	3.960	2.810
3.810	149.8	165.1	4.360	2.770
3.810	151.6	143.3	4.240	2.730
3.810	149.8	140.2	4.280	2.810
3.810	137.3	139.7	4.250	2.930
3.810	137.9	154.2	4.40	2.950
5.995	64.09	90.67	8.856	3.910
5.995	55.92	84.19	9.318	3.950
5.995	56.34	85.01	9.360	4.030
5.995	56.04	88.60	9.440	4.130
5.995	60.10	88.46	9.280	4.150
5.995	-	-	9.560	4.150
9.144	63.04	114.4	18.44	6.600
9.144	64.35	121.7	18.32	6.800
9.144	58.49	108.3	18.48	6.800

Table A-IV Measured Blast Properties of Spherical PBX-108 (Cont'd)

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
9.144	61.04	113.6	18.60	6.600
9.144	59.72	115.7	18.44	6.600
9.144	66.20	120.0	18.76	6.600
11.58	-	-	24.51	7.200
11.58	-	-	24.46	7.200
11.58	-	-	24.64	7.000
11.58	29.08	69.71	24.80	6.800
11.58	31.03	63.36	24.64	7.000
11.58	28.72	-	25.00	7.400
13.72	34.34	81.63	30.00	7.800
13.72	-	-	29.90	7.800
13.72	31.92	76.53	30.20	7.800
13.72	32.54	79.08	30.36	7.600
13.72	31.29	79.98	30.20	7.800
13.72	-	68.95	30.68	7.600
16.46	25.59	-	37.37	8.020

Table A-V. Measured Blast Properties of Spherical PBX-109

R m	P k Pa	I k Pa-ms	t_a ms	t_+ ms
.9144	-	-	-	-
1.981	719.8	182.4	1.212	1.570
1.981	-	-	1.200	-
1.981	640.5	-	-	-
1.981	695.7	-	-	-
2.362	539.0	197.3	1.736	1.59
2.362	-	143.3	1.720	1.47
2.362	-	-	1.720	-
2.362	-	-	1.562	-
2.972	287.2	218.6	2.736	2.010
2.972	-	-	2.92	-
2.972	-	-	2.88	-
2.972	-	-	2.84	-
3.810	162.2	122.4	4.040	2.210
3.810	181.5	188.0	4.268	2.890
3.810	-	-	4.440	-
3.810	152.1	137.1	4.360	2.810
3.810	152.5	127.4	4.36	2.470
3.810	148.2	133.5	-	2.790
5.995	64.90	108.0	8.892	5.600
5.995	-	-	9.298	-
5.995	55.90	92.04	9.600	5.200
5.995	-	-	9.534	-
5.995	-	-	9.640	-
9.144	64.71	126.4	18.42	6.400
9.144	67.24	142.0	18.42	6.600
9.144	57.16	115.6	18.52	6.400
9.144	-	-	18.56	-
9.144	62.33	127.6	18.68	6.200
11.58	45.71	103.4	24.49	7.000
11.58	41.37	98.87	24.58	7.200
11.58	47.99	103.2	24.64	6.800
11.58	-	-	24.53	-
11.58	-	-	24.88	-
13.72	34.27	81.84	30.00	7.000
13.72	37.64	100.6	30.14	7.400
13.72	32.34	81.77	30.20	7.200
13.72	-	-	30.32	-
13.72	-	-	30.56	-
16.46	14.69	-	37.32	-

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite In Free Air

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.51571E 00	0.41635E 04	0.16586E 00	0.17172E 03
0.52078E 00	0.40902E 04	0.16957E 00	0.17145E 03
0.52590E 00	0.40180E 04	0.17233E 00	0.17116E 03
0.53107E 00	0.39469E 04	0.17513E 00	0.17087E 03
0.53629E 00	0.38769E 04	0.17798E 00	0.17058E 03
0.54156E 00	0.38079E 04	0.18088E 00	0.17027E 03
0.54689E 00	0.37400E 04	0.18383E 00	0.16996E 03
0.55226E 00	0.36731E 04	0.18683E 00	0.16965E 03
0.55769E 00	0.36072E 04	0.18989E 00	0.16932E 03
0.56317E 00	0.35423E 04	0.19299E 00	0.16900E 03
0.56871E 00	0.34784E 04	0.19615E 00	0.16866E 03
0.57430E 00	0.34155E 04	0.19936E 00	0.16831E 03
0.57995E 00	0.33536E 04	0.20262E 00	0.16796E 03
0.58565E 00	0.32926E 04	0.20595E 00	0.16760E 03
0.59141E 00	0.32326E 04	0.20933E 00	0.16724E 03
0.59722E 00	0.31735E 04	0.21277E 00	0.16687E 03
0.60309E 00	0.31154E 04	0.21626E 00	0.16650E 03
0.60902E 00	0.30581E 04	0.21982E 00	0.16611E 03
0.61501E 00	0.30018E 04	0.22344E 00	0.16573E 03
0.62105E 00	0.29463E 04	0.22712E 00	0.16533E 03
0.62716E 00	0.28918E 04	0.23087E 00	0.16493E 03
0.63332E 00	0.28381E 04	0.23468E 00	0.16452E 03
0.63955E 00	0.27852E 04	0.23855E 00	0.16411E 03
0.64584E 00	0.27332E 04	0.24249E 00	0.16369E 03
0.65219E 00	0.26821E 04	0.24551E 00	0.16327E 03
0.65860E 00	0.26318E 04	0.25059E 00	0.16284E 03
0.66507E 00	0.25823E 04	0.25474E 00	0.16240E 03
0.67161E 00	0.25336E 04	0.25896E 00	0.16196E 03
0.67821E 00	0.24857E 04	0.26326E 00	0.16151E 03
0.68488E 00	0.24385E 04	0.26763E 00	0.16106E 03
0.69161E 00	0.23922E 04	0.27208E 00	0.16061E 03
0.69841E 00	0.23466E 04	0.27660E 00	0.16013E 03
0.70528E 00	0.23018E 04	0.28120E 00	0.15966E 03
0.71221E 00	0.22577E 04	0.28589E 00	0.15919E 03
0.71921E 00	0.22144E 04	0.29065E 00	0.15870E 03
0.72629E 00	0.21718E 04	0.29550E 00	0.15822E 03
0.73342E 00	0.21298E 04	0.30043E 00	0.15773E 03
0.74063E 00	0.20886E 04	0.30545E 00	0.15723E 03
0.74791E 00	0.20481E 04	0.31056E 00	0.15673E 03
0.75527E 00	0.20083E 04	0.31576E 00	0.15622E 03
0.76269E 00	0.19692E 04	0.32105E 00	0.15571E 03
0.77019E 00	0.19307E 04	0.32643E 00	0.15519E 03
0.77776E 00	0.18929E 04	0.33190E 00	0.15467E 03
0.78541E 00	0.18557E 04	0.33747E 00	0.15414E 03
0.79313E 00	0.18192E 04	0.34314E 00	0.15361E 03
0.80093E 00	0.17833E 04	0.34891E 00	0.15307E 03
0.80880E 00	0.17480E 04	0.35478E 00	0.15253E 03
0.81675E 00	0.17134E 04	0.36075E 00	0.15198E 03
0.82478E 00	0.16793E 04	0.36683E 00	0.15143E 03
0.83289E 00	0.16459E 04	0.37301E 00	0.15086E 03

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.84108E 00	0.16130E 04	0.37931E 00	0.15032E 03
0.84934E 00	0.15807E 04	0.38571E 00	0.14975E 03
0.85769E 00	0.15490E 04	0.39223E 00	0.14919E 03
0.86613E 00	0.15178E 04	0.39887E 00	0.14861E 03
0.87464E 00	0.14872E 04	0.40562E 00	0.14804E 03
0.88324E 00	0.14571E 04	0.41249E 00	0.14746E 03
0.89192E 00	0.14276E 04	0.41948E 00	0.14687E 03
0.90069E 00	0.13986E 04	0.42660E 00	0.14628E 03
0.90954E 00	0.13701E 04	0.43384E 00	0.14569E 03
0.91849E 00	0.13422E 04	0.44121E 00	0.14509E 03
0.92752E 00	0.13147E 04	0.44871E 00	0.14449E 03
0.93663E 00	0.12877E 04	0.45635E 00	0.14389E 03
0.94584E 00	0.12613E 04	0.46412E 00	0.14328E 03
0.95514E 00	0.12353E 04	0.47203E 00	0.14267E 03
0.96453E 00	0.12098E 04	0.48008E 00	0.14206E 03
0.97401E 00	0.11847E 04	0.48827E 00	0.14144E 03
0.98359E 00	0.11602E 04	0.49661E 00	0.14082E 03
0.99326E 00	0.11360E 04	0.50510E 00	0.14019E 03
0.10030E 01	0.11123E 04	0.51374E 00	0.13956E 03
0.10129E 01	0.10891E 04	0.52254E 00	0.13893E 03
0.10228E 01	0.10663E 04	0.53149E 00	0.13830E 03
0.10329E 01	0.10439E 04	0.54060E 00	0.13766E 03
0.10430E 01	0.10220E 04	0.54988E 00	0.13702E 03
0.10533E 01	0.10004E 04	0.55932E 00	0.13638E 03
0.10637E 01	0.97926E 03	0.56893E 00	0.13573E 03
0.10741E 01	0.95852E 03	0.57871E 00	0.13508E 03
0.10847E 01	0.93817E 03	0.58867E 00	0.13443E 03
0.10953E 01	0.91820E 03	0.59881E 00	0.13378E 03
0.11061E 01	0.89862E 03	0.60913E 00	0.13312E 03
0.11170E 01	0.87941E 03	0.61964E 00	0.13246E 03
0.11280E 01	0.86057E 03	0.63033E 00	0.13180E 03
0.11390E 01	0.84209E 03	0.64122E 00	0.13114E 03
0.11502E 01	0.82396E 03	0.65230E 00	0.13047E 03
0.11616E 01	0.80619E 03	0.66359E 00	0.12980E 03
0.11730E 01	0.78876E 03	0.67507E 00	0.12913E 03
0.11845E 01	0.77167E 03	0.68677E 00	0.12846E 03
0.11961E 01	0.75492E 03	0.69868E 00	0.12779E 03
0.12079E 01	0.73849E 03	0.71080E 00	0.12711E 03
0.12198E 01	0.72238E 03	0.72314E 00	0.12643E 03
0.12318E 01	0.70659E 03	0.73571E 00	0.12575E 03
0.12439E 01	0.69111E 03	0.74850E 00	0.12507E 03
0.12561E 01	0.67593E 03	0.76153E 00	0.12439E 03
0.12685E 01	0.66106E 03	0.77479E 00	0.12370E 03
0.12809E 01	0.64648E 03	0.78829E 00	0.12302E 03
0.12935E 01	0.63219E 03	0.80204E 00	0.12233E 03
0.13062E 01	0.61819E 03	0.81604E 00	0.12164E 03
0.13191E 01	0.60446E 03	0.83029E 00	0.12095E 03
0.13320E 01	0.59101E 03	0.84482E 00	0.12026E 03
0.13451E 01	0.57782E 03	0.85963E 00	0.11957E 03
0.13584E 01	0.56489E 03	0.87476E 00	0.11888E 03

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.13717E 01	0.55220E 03	0.89023E 00	0.11820E 03
0.13862E 01	0.53974E 03	0.90605E 00	0.11751E 03
0.13988E 01	0.52752E 03	0.92226E 00	0.11684E 03
0.14126E 01	0.51552E 03	0.93889E 00	0.11617E 03
0.14265E 01	0.50373E 03	0.95595E 00	0.11550E 03
0.14405E 01	0.49216E 03	0.97349E 00	0.11485E 03
0.14546E 01	0.48079E 03	0.99153E 00	0.11420E 03
0.14689E 01	0.46961E 03	0.10101E 01	0.11356E 03
0.14834E 01	0.45863E 03	0.10292E 01	0.11294E 03
0.14980E 01	0.44784E 03	0.10490E 01	0.11232E 03
0.15127E 01	0.43723E 03	0.10694E 01	0.11172E 03
0.15276E 01	0.42679E 03	0.10905E 01	0.11113E 03
0.15426E 01	0.41653E 03	0.11123E 01	0.11056E 03
0.15577E 01	0.40645E 03	0.11349E 01	0.11000E 03
0.15731E 01	0.39653E 03	0.11583E 01	0.10945E 03
0.15885E 01	0.38680E 03	0.11825E 01	0.10891E 03
0.16041E 01	0.37725E 03	0.12075E 01	0.10839E 03
0.16199E 01	0.36790E 03	0.12333E 01	0.10788E 03
0.16358E 01	0.35874E 03	0.12599E 01	0.10737E 03
0.16519E 01	0.34978E 03	0.12873E 01	0.10686E 03
0.16682E 01	0.34102E 03	0.13154E 01	0.10637E 03
0.16846E 01	0.33246E 03	0.13443E 01	0.10587E 03
0.17011E 01	0.32412E 03	0.13740E 01	0.10538E 03
0.17178E 01	0.31597E 03	0.14044E 01	0.10488E 03
0.17347E 01	0.30804E 03	0.14355E 01	0.10438E 03
0.17518E 01	0.30031E 03	0.14674E 01	0.10388E 03
0.17690E 01	0.29280E 03	0.14999E 01	0.10338E 03
0.17864E 01	0.28549E 03	0.15331E 01	0.10286E 03
0.18040E 01	0.27838E 03	0.15669E 01	0.10236E 03
0.18217E 01	0.27148E 03	0.16013E 01	0.10182E 03
0.18396E 01	0.26479E 03	0.16363E 01	0.10124E 03
0.18577E 01	0.25829E 03	0.16718E 01	0.10071E 03
0.18759E 01	0.25200E 03	0.17078E 01	0.10017E 03
0.18944E 01	0.24590E 03	0.17443E 01	0.99501E 02
0.19130E 01	0.24000E 03	0.17811E 01	0.99001E 02
0.19318E 01	0.23429E 03	0.18183E 01	0.98304E 02
0.19508E 01	0.22877E 03	0.18557E 01	0.97771E 02
0.19700E 01	0.22344E 03	0.18934E 01	0.97131E 02
0.19893E 01	0.21828E 03	0.19313E 01	0.96475E 02
0.20089E 01	0.21329E 03	0.19695E 01	0.95804E 02
0.20287E 01	0.20846E 03	0.20079E 01	0.95120E 02
0.20486E 01	0.20378E 03	0.20466E 01	0.94424E 02
0.20687E 01	0.19925E 03	0.20856E 01	0.93717E 02
0.20891E 01	0.19485E 03	0.21249E 01	0.93000E 02
0.21096E 01	0.19059E 03	0.21645E 01	0.92275E 02
0.21304E 01	0.18645E 03	0.22044E 01	0.91541E 02
0.21513E 01	0.18244E 03	0.22446E 01	0.90802E 02
0.21724E 01	0.17854E 03	0.22852E 01	0.90057E 02
0.21938E 01	0.17475E 03	0.23262E 01	0.89307E 02
0.22154E 01	0.17106E 03	0.23676E 01	0.88555E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.22371E 01	0.18748E 03	0.24094E 01	0.87800E 02
0.22501E 01	0.18399E 03	0.24516E 01	0.87043E 02
0.22813E 01	[illegible]	[illegible]	[illegible]
0.23038E 01	0.15728E 03	0.25376E 01	0.85580E 02
0.23264E 01	0.15406E 03	0.25813E 01	0.84775E 02
0.23403E 01	0.15092E 03	0.26256E 01	0.84092E 02
0.23724E 01	0.14788E 03	0.26708E 01	0.83272E 02
0.23987E 01	0.14488E 03	0.27161E 01	0.82525E 02
0.24103E 01	0.14193E 03	0.27623E 01	0.81734E 02
0.24430E 01	0.13907E 03	0.28092E 01	0.81047E 02
0.24671E 01	0.13628E 03	0.28569E 01	0.80316E 02
0.24913E 01	0.13355E 03	0.29053E 01	0.79592E 02
0.25158E 01	0.13088E 03	0.29546E 01	0.78874E 02
0.25405E 01	0.12827E 03	0.30046E 01	0.78163E 02
0.25655E 01	0.12572E 03	0.30555E 01	0.77487E 02
0.25907E 01	0.12323E 03	0.31073E 01	0.76785E 02
0.26162E 01	0.12079E 03	0.31598E 01	0.76085E 02
0.26419E 01	0.11840E 03	0.32133E 01	0.75378E 02
0.26679E 01	0.11607E 03	0.32676E 01	0.74698E 02
0.26941E 01	0.11379E 03	0.33228E 01	0.74023E 02
0.27206E 01	0.11155E 03	0.33789E 01	0.73354E 02
0.27474E 01	0.10937E 03	0.34360E 01	0.72691E 02
0.27744E 01	0.10723E 03	0.34940E 01	0.72033E 02
0.28016E 01	0.10514E 03	0.35529E 01	0.71382E 02
0.28292E 01	0.10310E 03	0.36128E 01	0.70736E 02
0.28570E 01	0.10110E 03	0.36737E 01	0.70096E 02
0.28851E 01	0.99148E 02	0.37356E 01	0.69462E 02
0.29134E 01	0.97232E 02	0.37985E 01	0.68833E 02
0.29421E 01	0.95360E 02	0.38624E 01	0.68210E 02
0.29710E 01	0.93528E 02	0.39274E 01	0.67592E 02
0.30002E 01	0.91735E 02	0.39934E 01	0.66980E 02
0.30297E 01	0.89982E 02	0.40605E 01	0.66373E 02
0.30595E 01	0.88265E 02	0.41288E 01	0.65771E 02
0.30896E 01	0.86585E 02	0.41981E 01	0.65175E 02
0.31109E 01	0.84942E 02	0.42685E 01	0.64584E 02
0.31506E 01	0.83334E 02	0.43401E 01	0.63998E 02
0.31816E 01	0.81760E 02	0.44129E 01	0.63417E 02
0.32129E 01	0.80219E 02	0.44869E 01	0.62842E 02
0.32444E 01	0.78711E 02	0.45620E 01	0.62271E 02
0.32763E 01	0.77235E 02	0.46384E 01	0.61706E 02
0.33086E 01	0.75790E 02	0.47161E 01	0.61146E 02
0.33411E 01	0.74375E 02	0.47950E 01	0.60590E 02
0.33739E 01	0.72990E 02	0.48751E 01	0.60040E 02
0.34071E 01	0.71635E 02	0.49566E 01	0.59494E 02
0.34406E 01	0.70308E 02	0.50394E 01	0.58953E 02
0.34744E 01	0.69008E 02	0.51236E 01	0.58417E 02
0.35086E 01	0.67736E 02	0.52091E 01	0.57886E 02
0.35431E 01	0.66490E 02	0.52960E 01	0.57359E 02
0.35779E 01	0.65271E 02	0.53843E 01	0.56837E 02
0.36131E 01	0.64076E 02	0.54741E 01	0.56320E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.36486E 01	0.62007E 02	0.55653E 01	0.55807E 02
0.36844E 01	0.61761E 02	0.56579E 01	0.55200E 02
0.37207E 01	0.60630E 02	0.57521E 01	0.54705E 02
0.37572E 01	0.59841E 02	0.58478E 01	0.54206E 02
0.37942E 01	0.58485E 02	0.59451E 01	0.53801E 02
0.38315E 01	0.57411E 02	0.60430E 01	0.53311E 02
0.38691E 01	0.56370E 02	0.61443E 01	0.52825E 02
0.39072E 01	0.55367E 02	0.62463E 01	0.52343E 02
0.39456E 01	0.54377E 02	0.63500E 01	0.51866E 02
0.39844E 01	0.53407E 02	0.64554E 01	0.51393E 02
0.40236E 01	0.52456E 02	0.65624E 01	0.50924E 02
0.40631E 01	0.51525E 02	0.66712E 01	0.50450E 02
0.41031E 01	0.50613E 02	0.67817E 01	0.49998E 02
0.41434E 01	0.49710E 02	0.68940E 01	0.49541E 02
0.41841E 01	0.48843E 02	0.70081E 01	0.49088E 02
0.42253E 01	0.47985E 02	0.71241E 01	0.48640E 02
0.42668E 01	0.47144E 02	0.72419E 01	0.48196E 02
0.43087E 01	0.46320E 02	0.73616E 01	0.47755E 02
0.43511E 01	0.45512E 02	0.74832E 01	0.47318E 02
0.43939E 01	0.44721E 02	0.76068E 01	0.46886E 02
0.44371E 01	0.43945E 02	0.77324E 01	0.46457E 02
0.44807E 01	0.43185E 02	0.78600E 01	0.46032E 02
0.45247E 01	0.42440E 02	0.79896E 01	0.45610E 02
0.45692E 01	0.41710E 02	0.81213E 01	0.45193E 02
0.46141E 01	0.40994E 02	0.82551E 01	0.44779E 02
0.46595E 01	0.40293E 02	0.83910E 01	0.44369E 02
0.47053E 01	0.39605E 02	0.85291E 01	0.43962E 02
0.47516E 01	0.38931E 02	0.86694E 01	0.43559E 02
0.47983E 01	0.38270E 02	0.88120E 01	0.43161E 02
0.48454E 01	0.37622E 02	0.89568E 01	0.42764E 02
0.48931E 01	0.36986E 02	0.91040E 01	0.42372E 02
0.49412E 01	0.36364E 02	0.92535E 01	0.41984E 02
0.49898E 01	0.35753E 02	0.94054E 01	0.41598E 02
0.50388E 01	0.35154E 02	0.95597E 01	0.41217E 02
0.50883E 01	0.34567E 02	0.97165E 01	0.40838E 02
0.51384E 01	0.33991E 02	0.98757E 01	0.40463E 02
0.51889E 01	0.33426E 02	0.10038E 02	0.40092E 02
0.52399E 01	0.32872E 02	0.10202E 02	0.39723E 02
0.52914E 01	0.32329E 02	0.10368E 02	0.39358E 02
0.53434E 01	0.31797E 02	0.10539E 02	0.38997E 02
0.53959E 01	0.31274E 02	0.10711E 02	0.38638E 02
0.54490E 01	0.30762E 02	0.10886E 02	0.38283E 02
0.55026E 01	0.30259E 02	0.11064E 02	0.37931E 02
0.55567E 01	0.29766E 02	0.11244E 02	0.37582E 02
0.56113E 01	0.29283E 02	0.11428E 02	0.37236E 02
0.56664E 01	0.28808E 02	0.11614E 02	0.36893E 02
0.57221E 01	0.28343E 02	0.11804E 02	0.36554E 02
0.57784E 01	0.27886E 02	0.11996E 02	0.36217E 02
0.58352E 01	0.27438E 02	0.12192E 02	0.35883E 02
0.58926E 01	0.26998E 02	0.12390E 02	0.35553E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IM (KPA-MS/KG**1/3)
0.47604E 01	0.79088E 02	0.94363E 01	0.82003E 02
0.47779E 01	0.78629E 02	0.94779E 01	0.81735E 02
0.47954E 01	0.78192E 02	0.95196E 01	0.81469E 02
0.48130E 01	0.77758E 02	0.95616E 01	0.81203E 02
0.48307E 01	0.77326E 02	0.96037E 01	0.80938E 02
0.48484E 01	0.76897E 02	0.96461E 01	0.80673E 02
0.48662E 01	0.76470E 02	0.96886E 01	0.80410E 02
0.48841E 01	0.76046E 02	0.97313E 01	0.80147E 02
0.49020E 01	0.75624E 02	0.97742E 01	0.79886E 02
0.49200E 01	0.75204E 02	0.98172E 01	0.79625E 02
0.49381E 01	0.74787E 02	0.98606E 01	0.79364E 02
0.49562E 01	0.74371E 02	0.99039E 01	0.79106E 02
0.49744E 01	0.73959E 02	0.99476E 01	0.78847E 02
0.49927E 01	0.73548E 02	0.99914E 01	0.78590E 02
0.50110E 01	0.73140E 02	0.10035E 02	0.78334E 02
0.50294E 01	0.72734E 02	0.10080E 02	0.78078E 02
0.50479E 01	0.72330E 02	0.10124E 02	0.77823E 02
0.50664E 01	0.71929E 02	0.10169E 02	0.77569E 02
0.50850E 01	0.71529E 02	0.10214E 02	0.77315E 02
0.51037E 01	0.71132E 02	0.10259E 02	0.77064E 02
0.51225E 01	0.70737E 02	0.10304E 02	0.76811E 02
0.51413E 01	0.70345E 02	0.10349E 02	0.76561E 02
0.51601E 01	0.69954E 02	0.10395E 02	0.76311E 02
0.51791E 01	0.69566E 02	0.10441E 02	0.76061E 02
0.51981E 01	0.69180E 02	0.10487E 02	0.75813E 02
0.52172E 01	0.68796E 02	0.10533E 02	0.75566E 02
0.52364E 01	0.68414E 02	0.10579E 02	0.75319E 02
0.52556E 01	0.68034E 02	0.10626E 02	0.75073E 02
0.52749E 01	0.67656E 02	0.10673E 02	0.74828E 02
0.52943E 01	0.67281E 02	0.10720E 02	0.74583E 02
0.53137E 01	0.66907E 02	0.10767E 02	0.74340E 02
0.53332E 01	0.66536E 02	0.10814E 02	0.74097E 02
0.53528E 01	0.66167E 02	0.10862E 02	0.73855E 02
0.53724E 01	0.65799E 02	0.10910E 02	0.73614E 02
0.53922E 01	0.65434E 02	0.10958E 02	0.73374E 02
0.54120E 01	0.65071E 02	0.11006E 02	0.73134E 02
0.54318E 01	0.64710E 02	0.11055E 02	0.72895E 02
0.54518E 01	0.64350E 02	0.11104E 02	0.72657E 02
0.54718E 01	0.63993E 02	0.11152E 02	0.72420E 02
0.54919E 01	0.63638E 02	0.11202E 02	0.72184E 02
0.55121E 01	0.63285E 02	0.11251E 02	0.71948E 02
0.55323E 01	0.62934E 02	0.11301E 02	0.71713E 02
0.55526E 01	0.62584E 02	0.11350E 02	0.71479E 02
0.55730E 01	0.62237E 02	0.11400E 02	0.71245E 02
0.55935E 01	0.61891E 02	0.11451E 02	0.71013E 02
0.56140E 01	0.61548E 02	0.11501E 02	0.70781E 02
0.56346E 01	0.61206E 02	0.11552E 02	0.70550E 02
0.56553E 01	0.60866E 02	0.11603E 02	0.70320E 02
0.56761E 01	0.60528E 02	0.11654E 02	0.70090E 02
0.56969E 01	0.60192E 02	0.11705E 02	0.69861E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA*MS/KG**1/3)
0.57178E 01	0.59858E 02	0.11757E 02	0.59634E 02
0.57386E 01	0.59526E 02	0.11809E 02	0.59406E 02
0.57600E 01	0.59196E 02	0.11861E 02	0.59177E 02
0.57811E 01	0.58867E 02	0.11913E 02	0.58953E 02
0.58023E 01	0.58540E 02	0.11966E 02	0.58728E 02
0.58236E 01	0.58218E 02	0.12018E 02	0.58504E 02
0.58450E 01	0.57892E 02	0.12071E 02	0.58280E 02
0.58664E 01	0.57571E 02	0.12124E 02	0.58057E 02
0.58880E 01	0.57251E 02	0.12178E 02	0.57835E 02
0.59096E 01	0.56933E 02	0.12231E 02	0.57613E 02
0.59313E 01	0.56617E 02	0.12285E 02	0.57393E 02
0.59531E 01	0.56303E 02	0.12339E 02	0.57173E 02
0.59749E 01	0.55991E 02	0.12394E 02	0.56953E 02
0.59968E 01	0.55680E 02	0.12448E 02	0.56735E 02
0.60189E 01	0.55371E 02	0.12503E 02	0.56517E 02
0.60410E 01	0.55063E 02	0.12558E 02	0.56300E 02
0.60632E 01	0.54758E 02	0.12614E 02	0.56083E 02
0.60854E 01	0.54454E 02	0.12669E 02	0.55867E 02
0.61078E 01	0.54151E 02	0.12725E 02	0.55652E 02
0.61302E 01	0.53851E 02	0.12781E 02	0.55438E 02
0.61527E 01	0.53552E 02	0.12838E 02	0.55224E 02
0.61753E 01	0.53255E 02	0.12894E 02	0.55011E 02
0.61980E 01	0.52959E 02	0.12951E 02	0.54799E 02
0.62207E 01	0.52665E 02	0.13008E 02	0.54588E 02
0.62436E 01	0.52373E 02	0.13065E 02	0.54377E 02
0.62665E 01	0.52082E 02	0.13123E 02	0.54167E 02
0.62895E 01	0.51793E 02	0.13181E 02	0.53957E 02
0.63126E 01	0.51506E 02	0.13239E 02	0.53749E 02
0.63358E 01	0.51220E 02	0.13297E 02	0.53540E 02
0.63591E 01	0.50936E 02	0.13356E 02	0.53333E 02
0.63824E 01	0.50652E 02	0.13415E 02	0.53126E 02
0.64058E 01	0.50371E 02	0.13474E 02	0.52920E 02
0.64294E 01	0.50092E 02	0.13533E 02	0.52714E 02
0.64530E 01	0.49814E 02	0.13593E 02	0.52509E 02
0.64767E 01	0.49537E 02	0.13653E 02	0.52305E 02
0.65004E 01	0.49262E 02	0.13713E 02	0.52102E 02
0.65243E 01	0.48989E 02	0.13773E 02	0.51899E 02
0.65483E 01	0.48717E 02	0.13834E 02	0.51697E 02
0.65723E 01	0.48446E 02	0.13895E 02	0.51496E 02
0.65964E 01	0.48177E 02	0.13956E 02	0.51295E 02
0.66207E 01	0.47910E 02	0.14018E 02	0.51095E 02
0.66450E 01	0.47644E 02	0.14080E 02	0.50895E 02
0.66694E 01	0.47380E 02	0.14142E 02	0.50696E 02
0.66939E 01	0.47117E 02	0.14204E 02	0.50498E 02
0.67184E 01	0.46855E 02	0.14267E 02	0.50301E 02
0.67431E 01	0.46595E 02	0.14329E 02	0.50104E 02
0.67679E 01	0.46336E 02	0.14393E 02	0.49908E 02
0.67927E 01	0.46079E 02	0.14456E 02	0.49712E 02
0.68177E 01	0.45823E 02	0.14520E 02	0.49517E 02
0.68427E 01	0.45569E 02	0.14584E 02	0.49323E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.68678E 01	0.45316E 02	0.14648E 02	0.59129E 02
0.68930E 01	0.45064E 02	0.14713E 02	0.58936E 02
0.69184E 01	0.44814E 02	0.14777E 02	0.58744E 02
0.69438E 01	0.44566E 02	0.14843E 02	0.58552E 02
0.69693E 01	0.44318E 02	0.14908E 02	0.58361E 02
0.69948E 01	0.44072E 02	0.14974E 02	0.58170E 02
0.70206E 01	0.43827E 02	0.15040E 02	0.57980E 02
0.70463E 01	0.43584E 02	0.15106E 02	0.57791E 02
0.70722E 01	0.43342E 02	0.15172E 02	0.57602E 02
0.70982E 01	0.43102E 02	0.15239E 02	0.57414E 02
0.71242E 01	0.42862E 02	0.15307E 02	0.57227E 02
0.71504E 01	0.42624E 02	0.15374E 02	0.57040E 02
0.71766E 01	0.42388E 02	0.15442E 02	0.56853E 02
0.72030E 01	0.42153E 02	0.15510E 02	0.56668E 02
0.72294E 01	0.41919E 02	0.15578E 02	0.56483E 02
0.72560E 01	0.41686E 02	0.15647E 02	0.56298E 02
0.72826E 01	0.41455E 02	0.15716E 02	0.56115E 02
0.73094E 01	0.41224E 02	0.15785E 02	0.55931E 02
0.73362E 01	0.40994E 02	0.15855E 02	0.55749E 02
0.73631E 01	0.40768E 02	0.15924E 02	0.55567E 02
0.73902E 01	0.40542E 02	0.15995E 02	0.55385E 02
0.74173E 01	0.40317E 02	0.16065E 02	0.55204E 02
0.74445E 01	0.40093E 02	0.16136E 02	0.55024E 02
0.74719E 01	0.39870E 02	0.16207E 02	0.54845E 02
0.74993E 01	0.39649E 02	0.16278E 02	0.54666E 02
0.75269E 01	0.39429E 02	0.16350E 02	0.54487E 02
0.75545E 01	0.39210E 02	0.16422E 02	0.54309E 02
0.75822E 01	0.38992E 02	0.16495E 02	0.54132E 02
0.76101E 01	0.38776E 02	0.16567E 02	0.53955E 02
0.76380E 01	0.38561E 02	0.16640E 02	0.53779E 02
0.76661E 01	0.38347E 02	0.16714E 02	0.53603E 02
0.76942E 01	0.38134E 02	0.16787E 02	0.53428E 02
0.77225E 01	0.37922E 02	0.16861E 02	0.53254E 02
0.77508E 01	0.37712E 02	0.16936E 02	0.53080E 02
0.77793E 01	0.37502E 02	0.17010E 02	0.52907E 02
0.78078E 01	0.37294E 02	0.17086E 02	0.52734E 02
0.78365E 01	0.37087E 02	0.17161E 02	0.52562E 02
0.78653E 01	0.36881E 02	0.17236E 02	0.52390E 02
0.78942E 01	0.36676E 02	0.17312E 02	0.52219E 02
0.79232E 01	0.36473E 02	0.17388E 02	0.52049E 02
0.79522E 01	0.36270E 02	0.17465E 02	0.51879E 02
0.79814E 01	0.36069E 02	0.17542E 02	0.51709E 02
0.80108E 01	0.35869E 02	0.17619E 02	0.51540E 02
0.80402E 01	0.35670E 02	0.17697E 02	0.51372E 02
0.80697E 01	0.35472E 02	0.17775E 02	0.51204E 02
0.80993E 01	0.35275E 02	0.17853E 02	0.51037E 02
0.81291E 01	0.35079E 02	0.17932E 02	0.50871E 02
0.81589E 01	0.34884E 02	0.18011E 02	0.50705E 02
0.81889E 01	0.34691E 02	0.18090E 02	0.50539E 02
0.82189E 01	0.34498E 02	0.18170E 02	0.50374E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IP (KPA-MS/KG**1/3)
0.82491E 01	0.34307E 02	0.18250E 02	0.50204E 02
0.82794E 01	0.34118E 02	0.18331E 02	0.50046E 02
0.83098E 01	0.33927E 02	0.18411E 02	0.49882E 02
0.83403E 01	0.33738E 02	0.18493E 02	0.49719E 02
0.83709E 01	0.33551E 02	0.18574E 02	0.49557E 02
0.84017E 01	0.33365E 02	0.18656E 02	0.49396E 02
0.84325E 01	0.33180E 02	0.18738E 02	0.49234E 02
0.84635E 01	0.32996E 02	0.18821E 02	0.49073E 02
0.84946E 01	0.32812E 02	0.18904E 02	0.48913E 02
0.85258E 01	0.32630E 02	0.18987E 02	0.48753E 02
0.85571E 01	0.32449E 02	0.19071E 02	0.48594E 02
0.85885E 01	0.32269E 02	0.19155E 02	0.48435E 02
0.86200E 01	0.32090E 02	0.19239E 02	0.48277E 02
0.86517E 01	0.31912E 02	0.19324E 02	0.48120E 02
0.86834E 01	0.31735E 02	0.19409E 02	0.47962E 02
0.87153E 01	0.31558E 02	0.19495E 02	0.47805E 02
0.87473E 01	0.31383E 02	0.19580E 02	0.47650E 02
0.87795E 01	0.31209E 02	0.19667E 02	0.47494E 02
0.88117E 01	0.31036E 02	0.19753E 02	0.47339E 02
0.88440E 01	0.30864E 02	0.19841E 02	0.47185E 02
0.88765E 01	0.30692E 02	0.19928E 02	0.47030E 02
0.89091E 01	0.30522E 02	0.20016E 02	0.46877E 02
0.89418E 01	0.30352E 02	0.20104E 02	0.46724E 02
0.89747E 01	0.30184E 02	0.20193E 02	0.46571E 02
0.90076E 01	0.30016E 02	0.20282E 02	0.46419E 02
0.90407E 01	0.29850E 02	0.20371E 02	0.46268E 02
0.90739E 01	0.29684E 02	0.20461E 02	0.46117E 02
0.91072E 01	0.29519E 02	0.20551E 02	0.45966E 02
0.91406E 01	0.29355E 02	0.20641E 02	0.45816E 02
0.91742E 01	0.29193E 02	0.20732E 02	0.45666E 02
0.92079E 01	0.29030E 02	0.20824E 02	0.45517E 02
0.92417E 01	0.28869E 02	0.20916E 02	0.45368E 02
0.92756E 01	0.28709E 02	0.21008E 02	0.45221E 02
0.93097E 01	0.28550E 02	0.21100E 02	0.45073E 02
0.93439E 01	0.28391E 02	0.21193E 02	0.44926E 02
0.93782E 01	0.28234E 02	0.21287E 02	0.44779E 02
0.94126E 01	0.28077E 02	0.21381E 02	0.44633E 02
0.94472E 01	0.27921E 02	0.21475E 02	0.44487E 02
0.94819E 01	0.27766E 02	0.21569E 02	0.44342E 02
0.95167E 01	0.27612E 02	0.21664E 02	0.44197E 02
0.95516E 01	0.27459E 02	0.21760E 02	0.44053E 02
0.95867E 01	0.27306E 02	0.21856E 02	0.43909E 02
0.96219E 01	0.27155E 02	0.21952E 02	0.43766E 02
0.96572E 01	0.27004E 02	0.22049E 02	0.43623E 02
0.96927E 01	0.26854E 02	0.22146E 02	0.43480E 02
0.97283E 01	0.26705E 02	0.22244E 02	0.43338E 02
0.97640E 01	0.26557E 02	0.22342E 02	0.43197E 02
0.97999E 01	0.26409E 02	0.22440E 02	0.43056E 02
0.98359E 01	0.26263E 02	0.22539E 02	0.42915E 02
0.98720E 01	0.26117E 02	0.22638E 02	0.42775E 02

Table A-VI. Smooth Values of Scaled Measured Blast Properties of Spherical Pentolite in Free Air (Cont'd)

Z (M/KG**1/3)	PM KPA	TA (MS/KG**1/3)	IMP (KPA-MS/KG**1/3)
0.99082E 01	0.25972E 02	0.22738E 02	0.42635E 02
0.99446E 01	0.25828E 02	0.22838E 02	0.42495E 02
0.99811E 01	0.25684E 02	0.22939E 02	0.42357E 02
0.10018E 02	0.25542E 02	0.23040E 02	0.42219E 02
0.10055E 02	0.25400E 02	0.23142E 02	0.42081E 02
0.10091E 02	0.25259E 02	0.23244E 02	0.41944E 02
0.10129E 02	0.25119E 02	0.23346E 02	0.41807E 02
0.10166E 02	0.24979E 02	0.23449E 02	0.41670E 02
0.10203E 02	0.24841E 02	0.23552E 02	0.41534E 02
0.10241E 02	0.24703E 02	0.23656E 02	0.41399E 02
0.10278E 02	0.24566E 02	0.23760E 02	0.41264E 02
0.10316E 02	0.24429E 02	0.23865E 02	0.41129E 02
0.10354E 02	0.24294E 02	0.23970E 02	0.40995E 02
0.10392E 02	0.24159E 02	0.24076E 02	0.40861E 02
0.10430E 02	0.24025E 02	0.24182E 02	0.40727E 02
0.10468E 02	0.23891E 02	0.24289E 02	0.40594E 02
0.10507E 02	0.23759E 02	0.24396E 02	0.40462E 02
0.10545E 02	0.23627E 02	0.24503E 02	0.40330E 02
0.10584E 02	0.23496E 02	0.24611E 02	0.40198E 02
0.10623E 02	0.23365E 02	0.24720E 02	0.40067E 02
0.10662E 02	0.23236E 02	0.24829E 02	0.39936E 02
0.10701E 02	0.23107E 02	0.24938E 02	0.39806E 02
0.10740E 02	0.22978E 02	0.25048E 02	0.39676E 02
0.10780E 02	0.22851E 02	0.25158E 02	0.39546E 02
0.10819E 02	0.22724E 02	0.25269E 02	0.39417E 02
0.10859E 02	0.22598E 02	0.25380E 02	0.39288E 02
0.10899E 02	0.22472E 02	0.25492E 02	0.39160E 02
0.10939E 02	0.22348E 02	0.25605E 02	0.39032E 02
0.10979E 02	0.22224E 02	0.25718E 02	0.38905E 02
0.11019E 02	0.22100E 02	0.25831E 02	0.38778E 02
0.11060E 02	0.21978E 02	0.25945E 02	0.38651E 02
0.11100E 02	0.21856E 02	0.26059E 02	0.38525E 02
0.11141E 02	0.21734E 02	0.26174E 02	0.38399E 02
0.11182E 02	0.21614E 02	0.26289E 02	0.38274E 02
0.11223E 02	0.21494E 02	0.26405E 02	0.38149E 02
0.11264E 02	0.21374E 02	0.26521E 02	0.38024E 02
0.11306E 02	0.21256E 02	0.26638E 02	0.37900E 02
0.11347E 02	0.21138E 02	0.26756E 02	0.37776E 02
0.11389E 02	0.21020E 02	0.26874E 02	0.37653E 02
0.11431E 02	0.20904E 02	0.26992E 02	0.37530E 02
0.11473E 02	0.20788E 02	0.27111E 02	0.37407E 02
0.11515E 02	0.20672E 02	0.27231E 02	0.37285E 02
0.11557E 02	0.20558E 02	0.27351E 02	0.37164E 02
0.11600E 02	0.20443E 02	0.27471E 02	0.37042E 02
0.11642E 02	0.20330E 02	0.27592E 02	0.36921E 02
0.11685E 02	0.20217E 02	0.27714E 02	0.36801E 02
0.11728E 02	0.20105E 02	0.27836E 02	0.36681E 02
0.11771E 02	0.19993E 02	0.27959E 02	0.36561E 02
0.11814E 02	0.19882E 02	0.28082E 02	0.36441E 02
0.11857E 02	0.19772E 02	0.28206E 02	0.36322E 02

Table A-VII. Coefficients Defining Fit of Cubic Equations to Pentolite Data for Free Air

PARAMETERS*	C0	C1	C2	C3	LOWER BD	UPPER BD
	0.30491E 01	-0.21543E 01	-0.59437E 00	0.14219E-13	-0.43775E 00	0.11698E 00
•	0.30615E 01	-0.24733E 01	0.21330E 01	-0.77719E 01	0.11698E 00	0.18953E 00
LOG (PM)	0.28880E 01	0.27231E 00	-0.12354E 02	0.17707E 02	0.18953E 00	0.28866E 00
	0.35039E 01	-0.61286E 01	0.98209E 01	-0.78997E 01	0.28866E 00	0.39085E 00
	0.30322E 01	-0.25081E 01	0.55802E 00	-0.13698E-13	0.39085E 00	0.14310E 01
	C0	C1	C2	C3	LOWER BD	UPPER BD
	-0.29153E 00	0.17341E 01	0.15211E 00	-0.12778E-12	-0.23303E 00	0.11698E 00
	-0.31777E 00	0.24072E 01	-0.56025E 01	0.16398E 02	0.11698E 00	0.18953E 00
LOG (TA	-0.42447E-01	-0.19509E 01	0.17392E 02	-0.24044E 02	0.18953E 00	0.28866E 00
	-0.88265E 00	0.67813E 01	-0.12859E 02	0.10889E 02	0.28866E 00	0.39085E 00
	-0.23250E 00	0.17910E 01	-0.91081E-01	0.42059E 12	0.39085E 00	0.58713E 00
	C0	C1	C2	C3	LOWER BD	UPPER BD
	-0.20431E 00	0.17217F 01	-0.25567E 01	-0.62383E-14	-0.23303E 00	0.11698E 00
	-0.24250E 00	0.27011E 01	-0.10929E 02	0.23859E 02	0.11698E 00	0.18953E 00
LOG (TD)	0.47544E-01	-0.18899E 01	0.13294E 02	-0.18745E 02	0.18953E 00	0.28866E 00
	-0.60601E 00	0.49024E 01	-0.10236E 02	0.84273E 01	0.28866E 00	0.39085E 00
	-0.10282E 00	0.10402E 01	-0.35489E 00	-0.26057E-14	0.39085E 00	0.12084E 01
	C0	C1	C2	C3	LOWER BD	UPPER BD
	0.21454E 01	-0.45972E 00	-0.51697E 00	0.21898E-12	-0.23303E 00	0.11698E 00
	0.21318E 01	-0.11149E 00	-0.34940E 01	0.84832E 01	0.11698E 00	0.18953E 00
LOG (IMP)	0.22806E 01	-0.24667E 01	0.89328E 01	-0.13373E 02	0.18953E 00	0.28866E 00
	0.17534E 01	0.30126E 01	-0.10049E 02	0.85473E 01	0.28866E 00	0.39085E 00
	0.22637E 01	-0.90459E 00	-0.27029E-01	-0.73091E-14	0.39085E 00	0.14310E 01

*the cubic equations were fit to imperical values of the parameters identified in parenthesis.

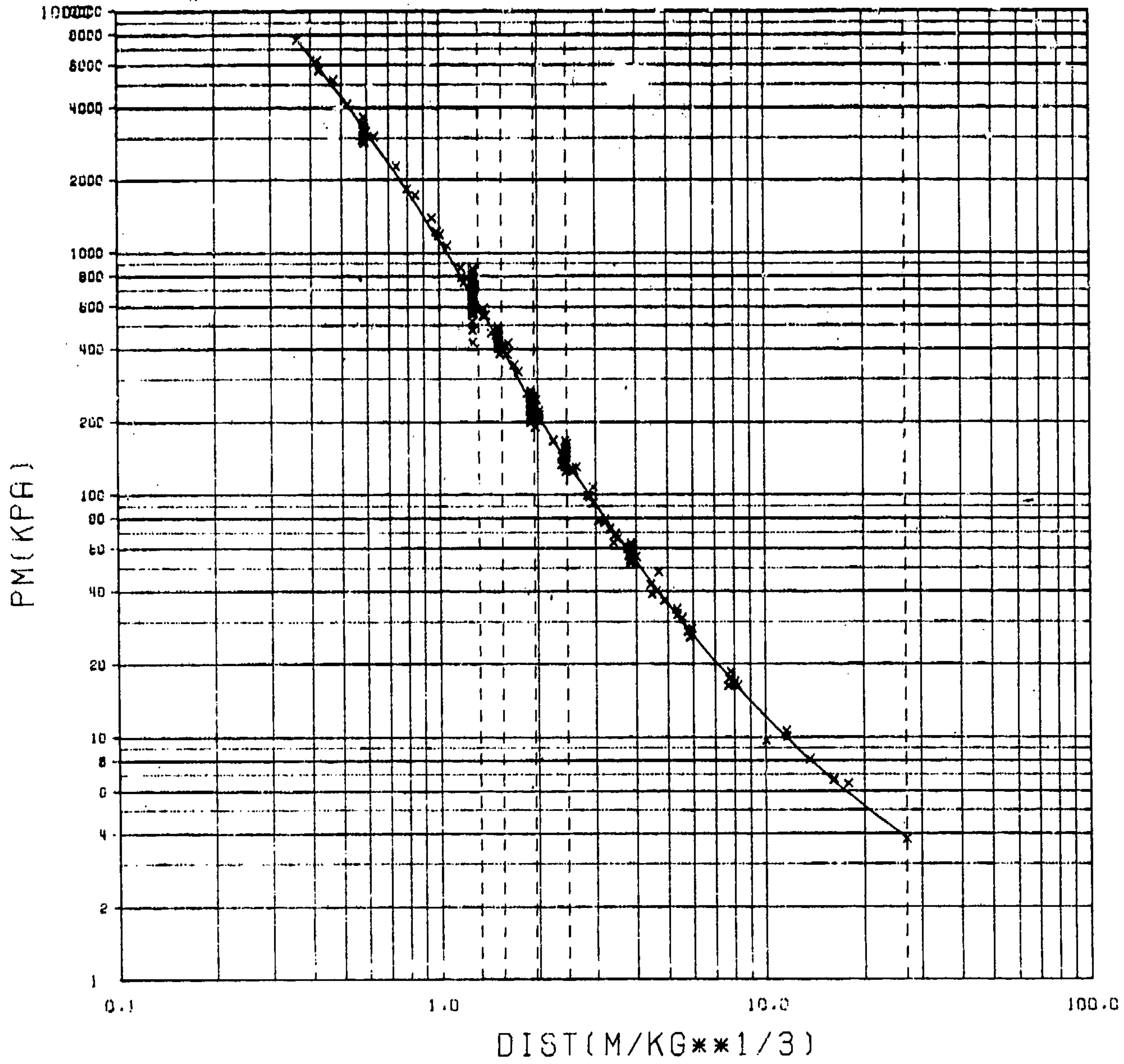

FIGURE A-1. PEAK EXCESS PRESSURE vs. SCALED DISTANCE in FREE AIR for PENTOLITE

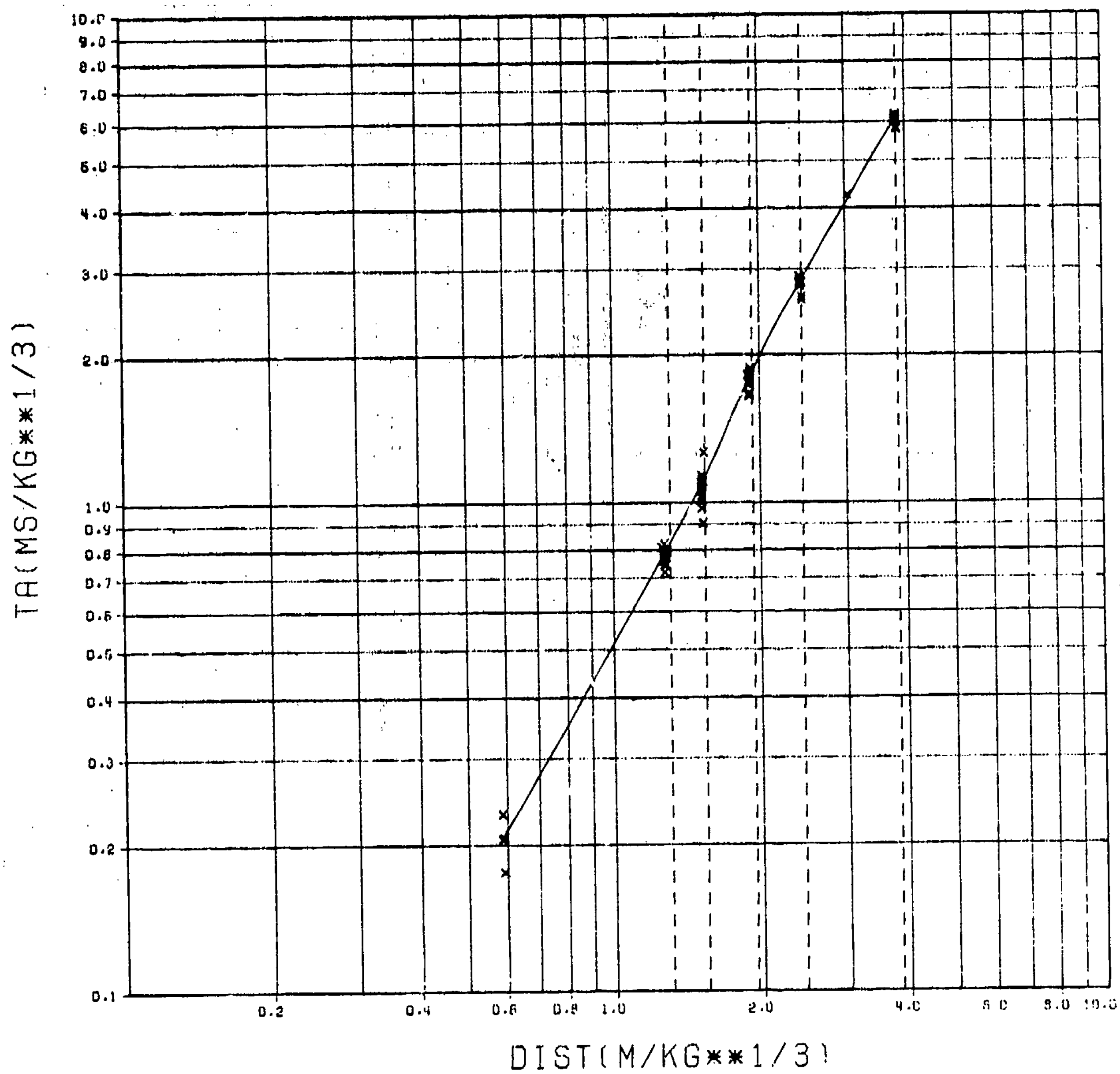

FIGURE A-2 SCALED TIME of ARRIVAL vs SCALED DISTANCE in FREE AIR for PENTOLITE

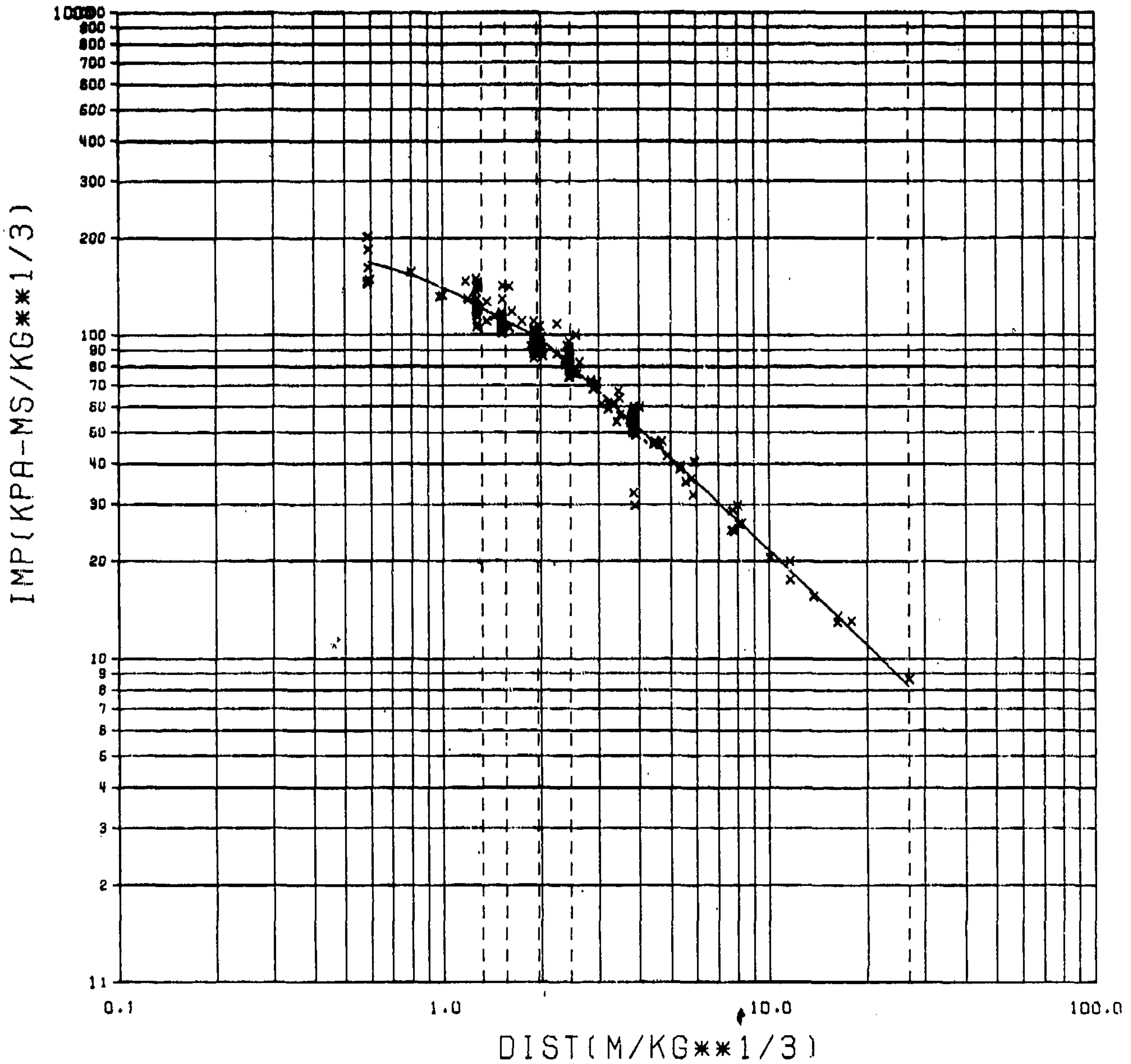

FIGURE A-3 SCALED POSITIVE IMPULSE vs SCALED DISTANCE in FREE AIR for PENTOLITE

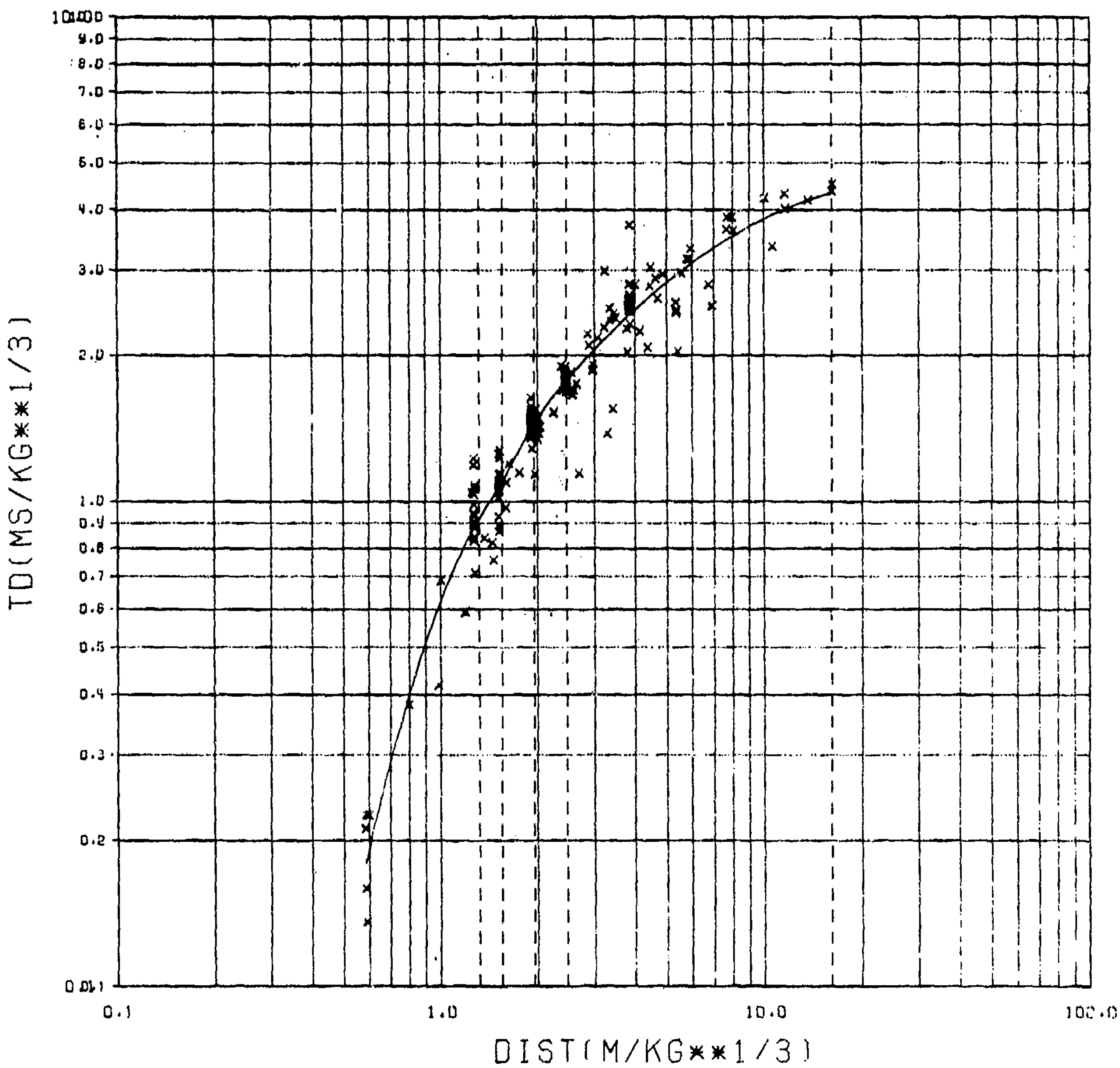

FIGURE A-4 SCALED POSITIVE PHASE DURATION vs SCALED DISTANCE in FREE AIR for PENTOLITE

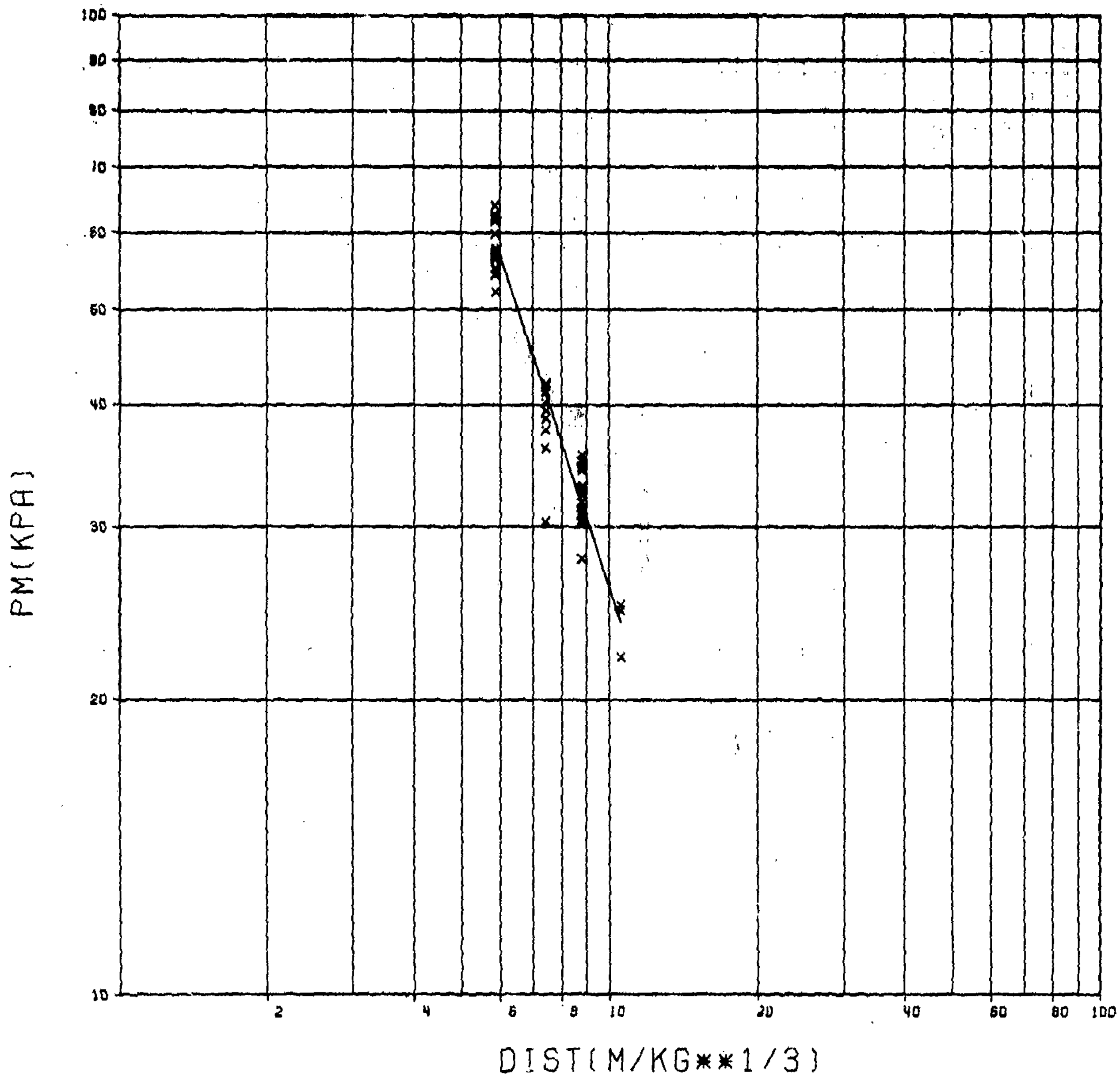

FIGURE A-5. PEAK EXCESS PRESSURE vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

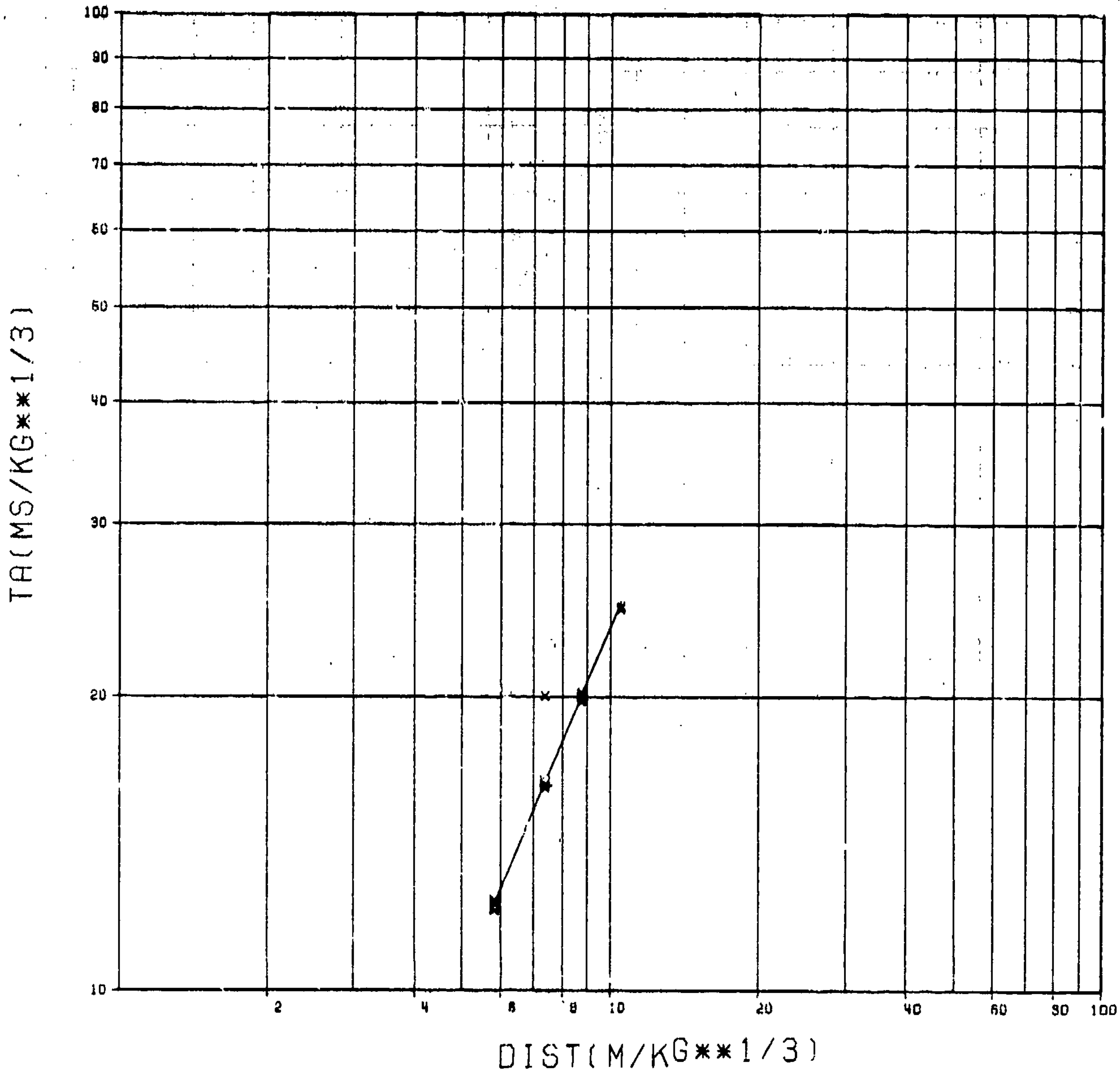

FIGURE A-6. SCALED TIME of ARRIVAL vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

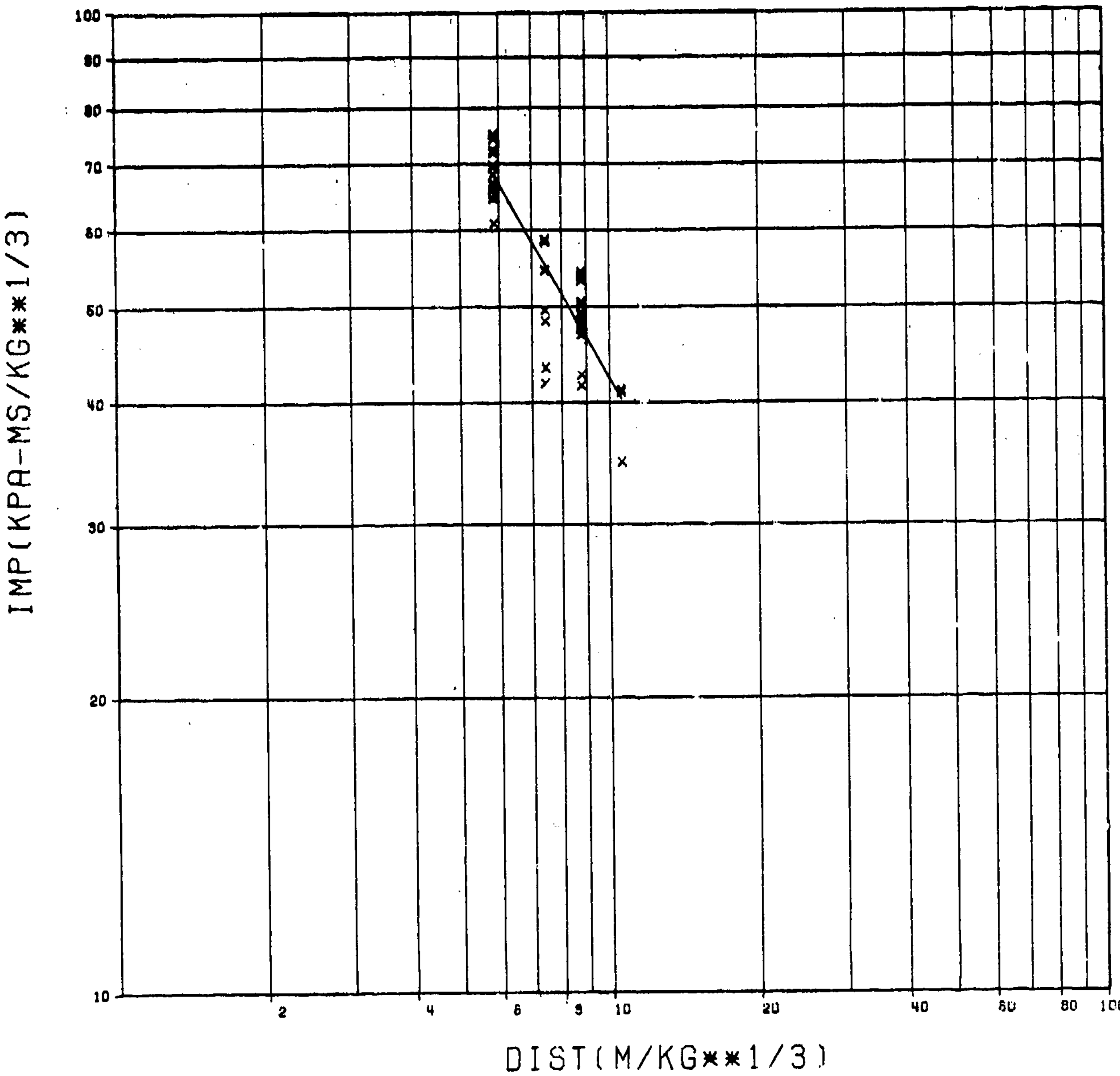

FIGURE A-7. SCALED IMPULSE vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

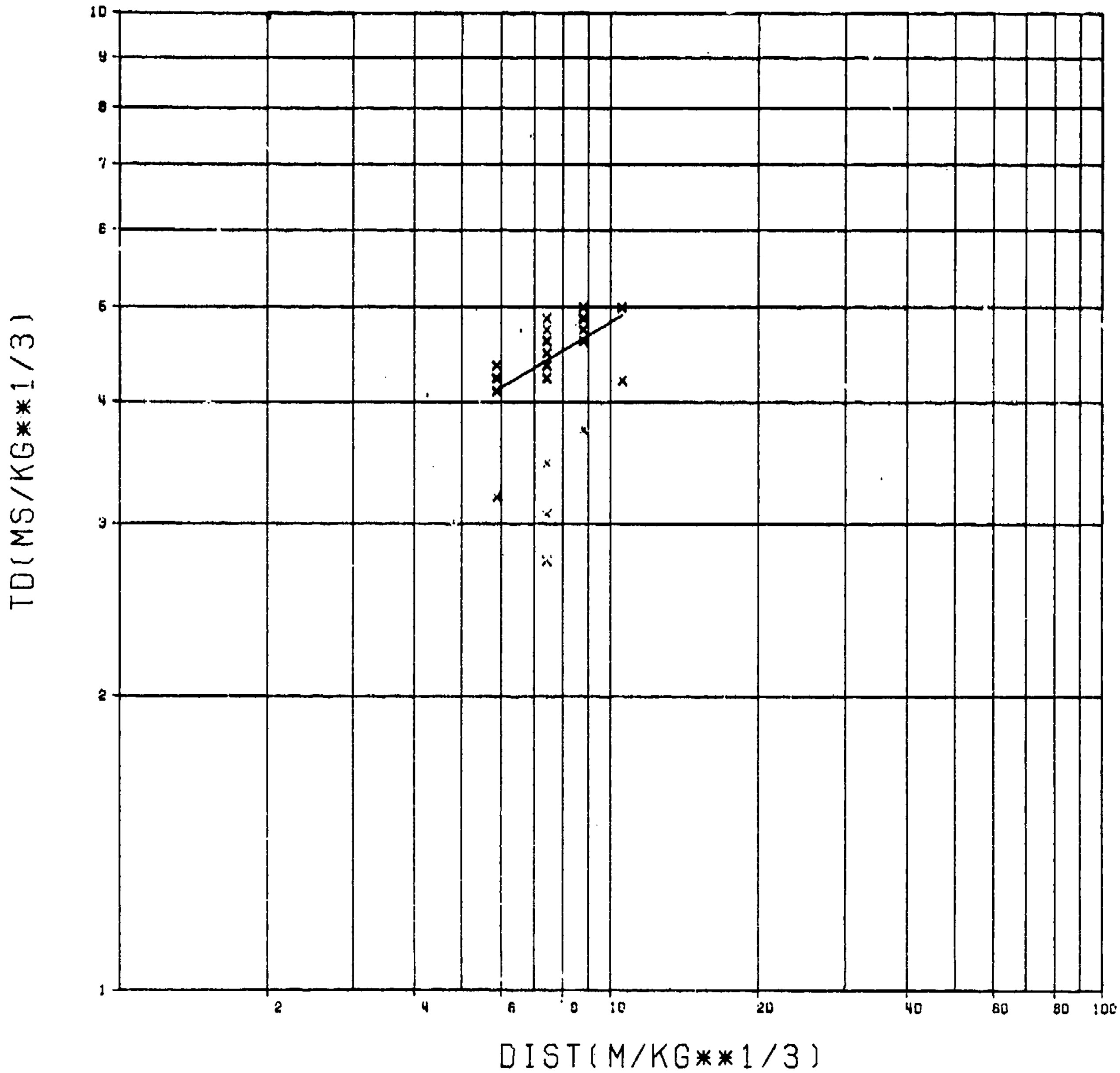

FIGURE A-8 SCALED POSITIVE PHASE DURATION vs SCALED DISTANCE in MACH STEM REGION for PENTOLITE

LIST OF SYMBOLS

a_{ij}	j-th decay coefficient in i-th cubic equation (Equation 6)
A_d	sound speed (Chapman Jouguet property)
AFX-103	test explosive, non-aluminized
AFX-702	test explosive, aluminized
C_1	decay constant (Equation 4)
C_2	decay constant (Equation 5)
Co,...,C3	computed values of decay coefficients $a_{io}, \ldots, a_{i3}$, respectively (see a_{ij} above)
DC_1	scaled decay constant ($= C_1/W^{1/3}$)
DIST	scaled distance ($=R/W^{1/3}$) for computer generated curves
DQ	detonation energy available for air shock (Chapman Jouguet property)
E	shock front energy
EN	scaled shock front energy ($= E/W^{1/3}$)
EWF	equivalent weight factor
E_d	internal energy (Chapman Jouguet property)
G	gage reading of (specified) air blast characteristic
GG	scaled gage reading ($= G/W^{1/3}$)
h	height of explosive charge
H-6	standard aluminized explosive
H_d	enthalpy (Chapman Jouguet property)
I	positive impulse
IMP	scaled positive impulse ($= I/W^{1/3}$)
p	excess pressure at time t
PBX-108	test explosive, non-aluminized

LIST OF SYMBOLS (Cont'd)

PBX-109	test explosive, aluminized
PM	peak excess pressure; overpressure
P_d	pressure (Chapman Jouguet property)
P_o	ambient pressure
R	distance from charge center to measurement station
R_o	charge radius
SIGMA	standard deviation
t	elapsed time after arrival of shock front
t_a	time of arrival of shock front
t_+	positive phase duration
T	ambient temperature
TA	scaled time of arrival ($= t_a/W^{1/3}$)
TD	scaled positive phase duration ($= t_+/W^{1/3}$)
T_d	temperature (Chapman Jouguet property)
U_d	wave velocity (Chapman Jouguet property)
V_d	particle velocity (Chapman Jouguet property)
W	explosive charge weight
Z	scaled distance ($= R/W^{1/3}$)

SUBSCRIPTS

a	used with t to identify "arrival" time
d	used with all Chapman Jouguet properties except DQ; identifies "detonation" property of explosive
i	used in a_{ij} to identify i-th; i = 1,2,3,...; equation in set of cubic equation with coefficients a_{ij}
j	used in a_{ij} to identify j-th; j - 0,1,2,3; coefficient

LIST OF SYMBOLS (Cont'd)

s, x	used as required to identify explosive; s = standard, x = test; with which any measurement, property, or characteristic is associated
+	used with t to identify "duration" time of positive phase
o	used with P to define "ambient" pressure; used with R to define distance of explosive surface from charge center, i.e., charge radius

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